SUPPLEMENT TO THE AUSTRALIAN ZOOLOGIST, Vol. 9, Part 4, December 9, 1940.

THE

AUSTRALIAN ZOOLOGIST

Issued by the
Royal Zoological Society of New South Wales

Vol. 9.—1937-40.

WITH THIRTY-SIX PLATES,
And numerous Text-figures.

Sydney:
Printed and Published for the Society by
The Sydney and Melbourne Publishing Co., Pty., Ltd., Sydney.

London:
Wheldon & Wesley, Ltd., 2, 3 and 4 Arthur Street, New Oxford Street, W.C.2.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

SOLD BY THE SOCIETY.

INDEX TO VOLUME IX.

THE AUSTRALIAN ZOOLOGIST

Issued by the
Royal Zoological Society of New South Wales

Edited by
A. F. BASSET HULL, M.B.E., F.R.Z.S.

Vol. 9—Part 1

Sydney, November 12, 1937.

(Price, 3/-)

All communications to be addressed to the Hon. Secretary,
Box 2399 M.M., General Post Office, Sydney.

Sydney:
Sydney and Melbourne Publishing Co., Ltd., 29 Alberta St.

London:
Wheldon & Wesley, Ltd., 2, 3, and 4 Arthur Street, New Oxford Street, W.C.2.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

Royal Zoological Society of New South Wales.

Established 1879.

REGISTERED UNDER THE COMPANIES ACT, 1899 (1917).

Patrons.

Sir Philip Street, K.C.M.G.,
Sir Philip Woolcott Game, G.B.E., K.C.B., D.S.O.

COUNCIL, 1937-1938.

President: Tom Iredale, F.R.Z.S.

Vice-Presidents:

Neville William Cayley, F.R.Z.S., Garnet Halloran, B.Sc. M.D., F.R.A.C.S., F.R.C.S. (Ed.), Frank Marshall, C.M.G., D.D.S., and Theodore Cleveland Roughley, B.Sc., F.R.Z.S.

Members:

Ernest John Bryce, F.R.G.S.
Clive William Firth.
William Butler Gurney.
Aubrey Halloran, B.A., LL.B.
Keith Alfred Hindwood.
Albert Littlejohn.
Ernest Frederick Pollock, J.P., F.R.G.S.
Noel Lee Roberts.
Michael Stanley Reid Sharland.
Gilbert Percy Whitley, F.R.Z.S.

Officers:

Honorary Secretary and Editor: Arthur Francis Basset Hull, M.B.E., F.R.Z.S.
Assistant Honorary Secretary: Miss Betty French.
Honorary Treasurer: Phillip Shipway.
Honorary Librarian: Albert Sherbourne Le Souef, C.M.Z.S.
Honorary Auditor: Robert John Stiffe, F.C.A. (Aust.).

OFFICERS OF SECTIONS (1937-38).

Avicultural Section.

Chairman: A. H. Brain.
Hon. Secretary: A. I. Ormsby, LL.B.

Budgerigar Section.

Chairman: R. J. Murray.
Hon. Secretary: F. Brennan.

Marine Zoological Section.

Chairman: C. F. Laseron.
Hon. Secretary: P. N. Whitley.

Ornithological Section

Chairman: Tom Iredale.
Hon. Secretary: Roy Cooper.

A BASIC LIST OF THE LAND MOLLUSCA OF AUSTRALIA.—PART II.

By Tom Iredale.*

(Plates i.-iii.)

Before continuing with the list an omission of importance must be recorded, which also necessitates a correction. Hedley & Musson described a *Diplommatina egregia,* and, on account of its appearance, so unlike that of any *Diplommatina,* I introduced a new generic name, *Famarinia,* for it. Further consideration suggested that it did not belong to the operculates at all, but that it was a relation of *Themapupa*; it did not, however, exactly agree, and between the two places it was overlooked. Upon realising the omission it was re-examined, and then was found to be the species which Pilsbry had named *Pupoides hedleyi,* and had introduced a section, *Glyptopupoides,* which was used. Thus to the synonymy of *Glyptopupoides* must be added:—

1933. *Famarinia* Iredale, Rec. Austr. Mus., Vol. xix., p. 56, August 2. Orthotype, *Diplommatina egregia* Hedley & Musson.

And the specific name will become—

Glyptopupoides egregia Hedley & Musson, 1891.

1891. *Diplommatina egregia* Hedley & Musson, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. vi., p. 561, text fig. 8, May 23, 1891. Calliungal, South Queensland.

1926. *Pupoides hedleyi* Pilsbry, Man. Conch. (Tryon), Ser. 2, Vol. xxvii., p. 252, pl. 31, fig. 15, March. Bundaberg, Queensland.
South Queensland.

Note.—Although Pilsbry separated it widely, this shell recalls *Pronesopupa* and may be related.

A minor omission may also be added:—

Mulathena translucens Gabriel, 1934.

1934. *Thalassohelix translucens* Gabriel, Mem. Nat. Mus., Melb., Vol. viii., p. 157, pl. xviii., figs. 1-3, September. Wilson's Promontory, Victoria.
Victoria (Wilson's Promontory).

Note.—This species was described by Gabriel under the generic name *Thalassohelix,* but that Neozelanic genus had been introduced many years previously, and after consideration definitely rejected.

Now to continue the list:—

Family Stenopylidae.

The extraordinary form here separated with family rank has been referred by Hedley to the Endodontidae. It disagrees with every member of that family in texture, form and apertural development. The mouth is thickened, almost closed, though there are internal lamellae, and there is no radial sculpture so characteristic of all Australasian "Endodontids".

Genus Stenopylis Fulton, 1914.

1914. *Stenopylis* Fulton, Ann. Mag. Nat. Hist., Ser. 8, Vol. xiv., p. 163, August 1. Orthotype, *Planispira hemiclausa* Tate.

The distribution of the unique species suggests subdivision at some later period, but good series are not yet available.

---

*Continued from Vol. viii., pt. 4, p. 333, 1937.

STENOPYLIS HEMICLAUSA Tate, 1894.

1894. *Planispira hemiclausa* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 192, November. Central Australia. Figd. Tate, Rep. Horn. Sci. Exped. Centr. Austr., pt. ii., Zool., p. 185, pl. xvii., fig. 1, February, 1896. Ilpilla Gorge, Spencer Gorge. Anatomical details, Hedley, *loc. cit.*, p. 221, fig. 50 (*Microphyura*). Refigured, Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, pp. 99, 114, pl. 3, figs. 115-118, September 19, 1917. (Chillagoe Caves, Queensland).
North Queensland (Chillagoe Caves, *living*). Central Australia.

Family NITORIDAE.

In an attempt to classify the Zonitid molluscs, it is necessary to recognise three families, the characters of which must be purely anatomical, as no striking shell features are noticeable. Thiele indeed utilised a Stirps Ariophantacea covering one family only, Ariophantidae, which, however, he divided into no less than eighteen subfamilies, forming a somewhat incongruous assembly. One of the subfamilies was the Helicarioninae, but as *Helicarion* is the oldest name in his grouping, the names of the stirps and Family should have been based on this name, as elsewhere this usage was followed. The subfamilies named were Kaliellinae, Ereptinae, Trochonanininae, Microcystinae, Sesarinae, Trochomorphinae, Cystopeltinae, Chroninae, Macrochlamydinae, Ariophantinae, Staffordiinae, Xestinae, Durgellinae, Sophininae, Helicarioninae, Girasiinae, Parmarioninae and Urocyclinae. Such a varied congregation admittedly needed revision, as Thiele indicated by noting the doubtful inclusion of some of the members. So at once the subfamilies may be regarded as distinct families, and thus an incorrect idea of their interrelationship dispelled. Then the further dubious subordinations can be reviewed, such as the inclusion of the Australian genus *Nitor* in the Trochonaninae, but *Nitor* is here differentiated with family rank.

Genus NITOR Gude, 1911.

1911. *Nitor* Gude, Proc. Mal. Soc. (Lond.), Vol. ix., p. 270, March 30; new name for

1861. *Thalassia* Albers, Die Heliceen, 2nd ed. (ed. Martens), pp. xvi., 59. Orthotype, *Helix subrugata* Pfeiffer = Reeve. Not *Thalassia* Gistel, Nat. Thier. Schulen, p. 163, 1848.

NITOR SUBRUGATUS Reeve, 1852.

1852. *Helix subrugata* Reeve, Conch. Icon., Vol. vii., Helix, pl. 128, sp. 773, December, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1851, p. 259, December 7, 1853. "New Zealand", error = Clarence River, New South Wales.

1864. *Helix graftonensis* Cox, Cat. Austr. Land Shells, Add. page No. 137. Clarence River, N.S.W. (Macgillivray).

1865. *Helix clarencensis* Cox, Proc. Zool. Soc. (Lond.), 1864, p. 595, May 2, 1865. Clarence River, N.S.W. (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 4, pl. iv., figs. 2 a-b, May, 1868.
Northern New South Wales.

Note.—Cox's Catalogue is dated 1864, and was issued some time after March; it appeared in a blue paper cover; a little later an edition of a slightly larger size came out in a grey paper cover, and included in this

was an additional page of descriptions of four new species, which were numbered 134, 135, 136, 137, but the page was not.

NITOR MORETONENSIS Reeve, 1854.

1854. *Helix moretonensis* Reeve, Conch. Icon., Vol. vii., pl. 188, sp. 1313, July, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 52, January 10, 1855). Moreton Bay, Queensland (Strange). Figd. Cox, Mon. Austr. Land Shells, p. 5, pl. x., figs. 2, 2a, May, 1868.
South Queensland.

NITOR KREFFTI Cox, 1864.

1864. *Helix kreffti* Cox, Cat. Austr. Land Shells, p. 21. Cape York, Queensland (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 2, pl. x., fig. 8, May, 1868 (*villaris*).
North Australia (Cape York).

Note.—On the islands of Torres Strait occurs a similar smaller shell, more depressed, and with a coloured anteperipheral band, which Brazier (Proc. Linn. Soc. N.S.W., Vol. i., p. 100, July, 1876) has recorded as *annulus*. It may be called *Nitor kreffti insularum* subsp. nov., the type coming from Murray Island, and measuring 14 mm. in breadth and 8 mm. in height. The texture is quite different from that of *Nitor* typical, and the shell lacks the keeling and sculpture, and may not even belong to this family, but, in the meantime, a subgeneric name, *Pravonitor,* is proposed. As shown hereafter, *yorkensis* and *villaris* do not refer to shells of this association, though in the past they have been confused.

NITOR PUDIBUNDUS Cox, 1868.

1868. *Helix pudibunda* Cox, Mon. Austr. Land Shells, p. 4, pl. ii., fig. 11, May. Richmond River, N.S.W. (Macgillivray).
Northern New South Wales.

Note.—This is not a typical *Nitor*, differing in texture and form, and approximates somewhat to *Malandena,* but until the animal characters are known it cannot be there associated; it may be, however, separated subgenerically as *Modonitor,* the columella being thickened and reflected, and the peripheral keel of *Nitor* is lacking. Note: Two other shells are of doubtful Australian status, viz., *Helix yorkensis* Reeve, Conch. Icon., Vol. vii., pl. 195, sp. 1372, September, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 145, April 11, 1855), Cape York, North Australia. The illustration is of a small elevated shell, and the description does not apply to any Cape York species yet known. Specimens in the Cox Collection with a note "These were sent from Cummings as *H. yorkensis*" are certainly not the species figured. The other species is *Helix ductilis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856, p. 385, May, 1857, Drayton Range, Queensland (Stutchbury). The type was figured by Cox (Mon. Austr. Land Shells, pl. xix., fig. 5, May, 1868) from a painting by Angas. The painting shows a widely umbilicated shell quite unlike any of the Australian forms yet known, and the collection credited to Stutchbury, from the Drayton Range, is full of erroneous localisation.

Family MICROCYSTIDAE.

The species tentatively allotted to this family are certainly conchologically separable from the preceding, and recall the true Microcystid shells, but they will probably be later segregated. Odhner examined the animals and radulae of some species, and showed that the latter differed

in the number and formation of the teeth. Thus the common *rustica* showed a formula with about forty laterals on each side, these being unicuspid. Other species with a similar number of teeth had the laterals bicuspid, and this seemed the more normal style. A third, however, had almost double the number of laterals, bicuspid, as usual, and this agreed with the radula of a member of a different family as noted hereafter.

These differences are here regarded as generic, and names introduced as follows:—*Expocystis,* with *Helix rustica* Pfeiffer as type; *Tarocystis,* with *Microcystis responsivus* Hedley as type; *Melocystis,* with *Helix circumcincta* Cox = *jacksoniensis* Gray as type, with also *Echonitor,* and *Periclocystis.*

Genus Expocystis *nov.*

Type, *Helix rustica* Pfeiffer.

Shell small, glassy, flattened, periphery rounded, umbilicus very narrow, but open, columella thickened and reflected.

Radular formula 26.14.1.14.26, teeth unicuspid.

Expocystis rusticus Pfeiffer, 1852.

1852. *Helix rustica* Pfeiffer, Zeitsch. für Malak., Year ix., No. 7, p. 112; July; new name for

1851. *Helix inconspicua* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 379, pl. ii., fig. 3a, "1852" = mid December, 1851. Islet in Trinity Bay, Queensland. Not *H. inconspicua* C. B. Adams, Contr. Conch., iii., p. 37, 1849.

1852. *Helix impexa* Reeve, Conch. Icon., Vol. vii., pl. 130, sp. 795, October; new name for *H. inconspicua* Forbes.

1864. *Helix crotali* Cox, Cat. Austr. Land Shells, p. 13; new name for *H. inconspicua* Forbes.

1854. *Helix villaris* Reeve, Conch. Icon., Vol. vii., pl. 195, sp. 1375, September, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 146, April 11, 1855). Lizard Is., North Australia. Figd. Cox, Mon. Austr. Land Shells, p. 2, pl. x., fig. 8, May, 1868.
North Queensland (Islands off coast).

Genus Tarocystis *nov.*

Type, *Microcystis responsivus* Hedley.

Shell similar to preceding, but flatter, with the columella thickened and angled, a keel running into the spirally grooved umbilicus.

Radular formula 32.12.1.12.32, teeth bicuspid.

Tarocystis responsivus Hedley, 1912.

1912. *Microcystis responsivus* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 262, pl. vii., figs. 36-38, December 13. Bottle Tree Scrub, west of Gladstone, Queensland (S.W. Jackson).
South Queensland.

Tarocystis fulvus Odhner, 1917.

1917. *Microcystis fulva* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 78, pl. iii., figs. 83-85, text figs. 28, 29, 30b, 32, 35a, September 19. Atherton, North Queensland.
North Queensland (Atherton Tableland).

Note.—The radular formula is given as 25.13.1.13.25, teeth bicuspid.

TAROCYSTIS ANTIQUUS Odhner, 1917.

1917. *Microcystis antiqua* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 97, pl. iii., figs. 104-106, September 19. Chillagoe Caves, Queensland (subfossil).
North Queensland (Chillagoe Caves district, *living*).

Note.—This species is commonly living around Chillagoe Caves, and was only found inside through accidental intrusion by means of cracks in the roofs of the caves.

Genus DENDRONITOR Iredale, 1933.

1933. *Dendronitor* Iredale, Rec. Austr. Mus., Vol. xix., p. 56, August 2. Orthotype, *Microcystis inscensa* Hedley.

DENDRONITOR INSCENSUS Hedley, 1912.

1912. *Microcystis inscensa* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 262, pl. vii., figs. 39-40; pl. viii., fig. 41, December 13. Coolabunia, Queensland.
South Queensland.

Genus MELOCYSTIS *nov.*

Type, *Helix circumcincta* Cox = *Helix jacksoniensis* Gray.

Shell similar to preceding, but larger and more conical, columella only slightly thickened and reflected, but not angulate, keel missing, umbilicus spirally striate.

Radular formula 60.13.1.13.60, teeth bicuspid.

MELOCYSTIS JACKSONIENSIS Gray, 1834.

1834. *Helix jacksoniensis* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 64, November 25. Near Port Jackson, New South Wales (Allan Cunningham). Figd. Reeve, Conch. Icon., Vol. vii., pl. 207, sp. 1462, December, 1854.

1868. *Helix circumcincta* Cox, Mon. Austr. Land Shells, p. 3, pl. v., fig. 6, May. New name for

1864. *Helix marmorata* Cox, Cat. Austr. Land Shells, p. 20. Kiama, New South Wales (Masters). Not *H. marmorata* Férussac, Tabl. Syst. Limaçons, p. 35, 1821.
New South Wales.

Genus ECHONITOR Iredale, 1937.

1937. *Echonitor* Iredale, South Austr. Nat., Vol. xviii., p. 27. Orthotype, *Thalassia cyrtochila* Gude.

ECHONITOR CYRTOCHILUS Gude, 1905.

1905. *Thalassia cyrtochila* Gude, Journ. Malac., Vol. xii., p. 12, pl. iii., figs. 2 a-b, April 7. Long Reef, South Australia.
South Australia.

ECHONITOR EUROXESTUS Iredale, 1937.

1937. *Echonitor euroxestus* Iredale, South Austr. Nat., Vol. xviii., p. 27, pl. i., fig. 19. Franklin Harbour, Eyre's Peninsula.
South Australia (Eyre's Peninsula).

Echonitor albumenoideus Cox, 1868.

1868. *Helix albumenoidea* Cox, Mon. Austr. Land Shells, p. 11, pl. xii., fig. 2, May. Flinder's Range, South Australia.
South Australia.

Echonitor waterhousei Cox, 1868.

1868. *Helix waterhousei* Cox, Mon. Austr. Land Shells, p. 3, pl. xix., figs. 6, 6a, May (from a painting of the type by Angas). New name for
1864. *Helix (Thalassia) subangulata* Angas, Proc. Zool. Soc. (Lond.), 1863, p. 521, April 20, 1864, ex A. Adams & Angas MS. South Australia (no exact locality). Not *Helix subangulata* Pfeiffer, Proc. Zool. Soc. (Lond.), 1854, p. 53, January 10, 1855.
South Australia.

Note.—This appears to be an erroneous locality, as no shell is at present known from South Australia in agreement.

Genus Periclocystis Iredale, 1937.

1937. *Periclocystis* Iredale, South Austr. Nat., Vol. xviii., p. 28. Orthotype, *P. ardeni* Iredale.

Periclocystis ardeni Iredale, 1937.

1937. *Periclocystis ardeni* Iredale, South Austr. Nat., Vol. xviii., p. 28, pl. ii., fig. 13. Blinman, South Australia.
South Australia.

Genus Alienitor *nov.*

Type, *Helix lyndhurstensis* Cox.

The species so-called by Cox is a small Zonitid of distinct appearance, recalling extralimital forms rather than the local *Nitor-Microcystis* series, being especially separable by the open umbilicus, and the straight, not reflected, columella. It may yet prove to belong to an alien group, hence the name to keep this suggestion under consideration.

Alienitor lyndhurstensis Cox, 1868.

1868. *Helix lyndhurstensis* Cox, Mon. Austr. Land Shells, p. 11, pl. xvii., fig. 1, May. Lyndhurst, Sydney, N.S.W. (R. L. King).
New South Wales.

Genus Westracystis Iredale, 1933.

1933. *Westracystis* Iredale, Rec. Austr. Mus., Vol. xix., p. 56, August 2. Orthotype, *Lamprocystis lissa* Smith.

Westracystis lissus Smith, 1894.

1894. *Lamprocystis lissa* Smith, Proc. Malac. Soc. (Lond.), Vol. i., p. 86, pl. vii., figs. 22-23, January. North West Australia.
North West Australia.

Family Macrochlamydidae.

Odhner showed that the animal of a Zonitid from the Bellenden Ker Range should be classed with *Macrochlamys*, as there was a large caudal horn and produced shell lobes. Nevertheless, the radula was very similar to that of (*Microcystis*) *circumcincta*, having the formula, 70.15,1.15.70, while "the anatomy of the genital organs corresponds entirely to that of *Micro-*

cystis fulva". The shell was larger than those of the *circumcincta* and *fulva* groups, and quite unlike that of *Nitor*, so that the family Macrochlamydidae is here used temporarily for the location of these larger Zonitids.

Genus Malandena Iredale, 1933.

1933. *Malandena* Iredale, Rec. Austr. Mus., Vol. xix., p. 56, August 2. Orthotype, *Macrochlamys suturalis* Odhner.

Malandena suturalis Odhner, 1917.

1917. *Macrochlamys suturalis* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 81, pl. iii., figs. 86-88, September 19. Bellenden Ker Mts., Queensland.
North Queensland (Bellenden Ker Range).

Family Helicarionidae.

The Vitrinid shells of Australia were early separated under a genus, *Helicarion,* based upon rather superficial animal features. All Australian Vitrinids were then classed under this generic name, and then the genus was regarded as being represented in India, and even Africa. Almost every alien animal investigated by the anatomist has proved dissimilar in detail, and probably the true range of *Helicarion* is quite restricted. I separated three groups as subgenera a few years ago, and these are here elevated to generic rank to assist in classifying this difficult group conchologically.

Genus Helicarion Férussac, 1819-1821.

1821. *Helicarion* Férussac, Tabl. Syst. Limaçons, p. 20, January, p. 16, June (Spelt *Helixarion,* but corrected in Errata); ex Plate ix., Hist. Moll., livr. 4, July 19, vernacular name on plate, but probably scientific name printed on wrapper. Haplotype (or Logotype, Gray, Proc. Zool. Soc. (Lond.), 1847, p. 169, November), *Helicarion cuvieri* Férussac.

Helicarion cuvieri Férussac, 1819-21.

1821. *Helixarion cuvieri* Férussac, Tabl. Syst. Limaçons, p. 20, January, p. 16, June; ex Hist. Moll., pl. ix., fig. livr. 4, July, 1819. Terres Australes = Tasmania.
1850. *Vitrina verreauxii* Pfeiffer, Proc. Zool. Soc. (Lond.), 1849, p. 132, January- June, 1850, Australia (Verreaux) = Tasmania.
[1871. *Helix (Paryphanta?) vitrinaformis* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., sp. 58, June, ex Cox MS. Tasmania.
1879. *Helix buttoni* Petterd, Mon. Land Shells Tasm., p. 55, April. New name for above on account of a prior *Nanina vitrinaformis* "Mousson", Paetel, Catalog. Conch., p. 85, 1873.]
Tasmania.

Helicarion niger Quoy & Gaimard, 1832.

1832. *Vitrina nigra* Quoy & Gaimard, Voy. Astrol., Zool., Vol. ii., p. 135, pl. ii., figs. 8-9. Western Port, Victoria.
Victoria.

Helicarion freycineti Férussac, 1821.

1821. *Helixarion freycineti* Férussac, Tabl. Syst. Limaçons, p. 24, January; p. 20, June; ex Hist. Moll., pl. ixA., figs. 3-4, livr. 13, 1821. Port Jackson, New South Wales.

1824. *Helicarion freycineti* Quoy & Gaimard, Voy. de l'Uranie, Atlas, Zool., pl. 67, fig. 1.

1824. *V.* (= *Helicolimax*) *australasia* Blainville, Dict. Sc. Nat. (Levr.), Vol. xxxii., p. 255, November 13 (Manuel, p. 462, 1825). New name for preceding.

1834. *Helix* (*Vitrina*) *helicarion* Voigt, Das Thierreich (Cuvier), Vol. iii., p. 76. New name for *H. freycineti* Q. & G.
New South Wales.

HELICARION VIRENS Pfeiffer, 1849.

1849. *Vitrina virens* Pfeiffer, Proc. Zool. Soc. (Lond.), 1848, p. 108, April 25, 1849. Locality unknown = Moreton Bay. Figd. Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. i., Abth. xi., p. 24, pl. v., figs. 5-7, 1854. Figd. Reeve, Conch. Icon., Vol. xiii., pl. iii., fig. 14, May, 1862.

1868. *Vitrina aquila* Cox, Mon. Austr. Land Shells, p. 109, pl. xviii., figs. 14, 14a, May. Eagle Scrub, Brisbane, Queensland.
South Queensland. Northern New South Wales. (Not Victoria).

HELICARION HYALINUS Pfeiffer, 1855.

1855. *Vitrina hyalina* Pfeiffer, Proc. Zool. Soc. (Lond.), 1854, p. 296, May 8, 1855. Moreton Bay, Queensland. Figd. Reeve, Conch. Icon., Vol. xiii., pl. ix., sp. 68, May, 1862. Cox, Mon. Austr. Land Shells, p. 85, pl. xiv., figs. 7-7a, May, 1868.

1882. *Helicarion coxiana* Godwin-Austen, Land and Freshwater Molluscs, India, pt. ii., p. 65, July, *nomen nudum*.

1883. *Helicarion helenae* Godwin-Austen, Land and Freshwater Molluscs, India, pt. iv., p. 146, pl. xli., figs. 1-8, October. Elizabeth Bay, Sydney, New South Wales (Imported).
South Queensland.

Memo.—This small tree-living Helicarionid with weak base, rather expanded mouth but rounded spire differs anatomically, as given by Godwin-Austen, cited above, and may be separated subgenerically as *Peloparion* nov.

HELICARION PLANILABRIS Cox, 1866.

1866. *Vitrina planilabris* Cox, Journ. de Conch., Vol. xiv., p. 45, January 1; Proc. Zool. Soc. (Lond.), 1865, p. 697, April 24, 1866. Mitchell River, New South Wales (Porter).

1868. *Vitrina macgillivrayi* Cox, Mon. Austr. Land Shells, p. 86, pl. xv., figs. 8-8a, May. New name for preceding.

1868. *Vitrina megastoma* Cox, Mon. Austr. Land Shells, p. 87, pl. xiv., figs. 13-13a, May. Clarence River, N.S.W. (Macgillivray).
Northern New South Wales. South Queensland.

Note.—This large species with its expansive mouth, its flattened upper surface, and its degenerate base appears to lean towards *Parmacochlea*, and may be subgenerically named *Parmavitrina*.

Genus VERCULARION Iredale, 1933.

1933. *Vercularion* Iredale, Rec. Austr. Mus., Vol. xix., p. 38, August 2. Orthotype, *Helicarion bullaceus* Odhner = *Helicarion brazieri* Cox, 1873.

VERCULARION BRAZIERI Cox, 1873.

1873. *Helicarion brazieri* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 151, June. Fitzroy Island, North Queensland.

1917. *Helicarion bullaceus* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 77, pl. iii., figs. 79-82, text fig. 27, September 19. Bellendenker Mts., North Queensland.
North Queensland.

VERCULARION STRANGEI Pfeiffer, 1850.

1850. *Vitrina strangei* Pfeiffer, Proc. Zool. Soc. (Lond.), 1849, p. 132, January-June, 1850. Brisbane, Queensland (Strange).

1854. *Vitrina strangei* Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xi., p. 17, pl. ii., figs. 9-12. Also Figd. Reeve, Conch. Icon., Vol. xiii., pl. viii., sp. 48, May, 1862. Cox, Mon. Austr. Land Shells, p. 85, pl. xiv., figs. 9a, 3a, May, 1868.
South Queensland.

VERCULARION LEUCOSPIRA Pfeiffer, 1857.

1857. *Vitrina leucospira* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856, p. 326, March 10, 1857. Australia = North New South Wales. Figd. Reeve, Conch. Icon., Vol. xiii., pl. vi., sp. 42, May, 1862. Copied Cox, Mon. Austr. Land Shells, p. 83, pl. xiv., fig. 6, May, 1868.
Northern New South Wales.

VERCULARION ROBUSTUS Gould, 1846.

1846. *Vitrina robusta* Gould, Proc. Bost. Soc. Nat. Hist., Vol. ii., p. 181 (dated November). New South Wales (Mr. Mitchell) = Parramatta, near Sydney. Figd. Cox, Mon. Austr. Land Shells, p. 84, pl. xx., fig. 17, May, 1868, from a painting by Angas of a specimen presented by Gould, in the British Museum.

1862 *Vitrina inflata* Reeve, Conch. Icon., Vol. xiii., pl. ix., sp. 64, May. Sydney, New South Wales.
New South Wales (Sydney district).

VERCULARION MASTERSI Cox, 1868.

1868. *Vitrina mastersi* Cox, Mon. Austr. Land Shells, p. 86, pl. xiv., figs. 12, 12a, May. Kiama, New South Wales (Masters).
Southern New South Wales.

Genus FASTOSARION Iredale, 1933.

1933. *Fastosarion* Iredale, Rec. Austr. Mus., Vol. xix., p. 37, August 2. Orthotype, *Vitrina superba* Cox.

FASTOSARION SUPERBUS Cox, 1871.

1871. *Vitrina superba* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 54, June 12. Mt. Dryander, Port Denison, Queensland. Figd. Cox, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. ii., 1887, p. 1063, pl. xxi., figs. 8-9, March 21, 1888.
Mid Queensland.

Genus LUINARION Iredale, 1933.

1933. *Luinarion* Iredale, Rec. Austr. Mus., Vol. xix., p. 38, August 2. Orthotype, *Helicarion thomsoni* Ancey = *Vitrina castanea* Pfeiffer.

LUINARION CASTANEUS Pfeiffer, 1853.

1853. *Vitrina castanea* Pfeiffer, Mon. Helic. Viv., Vol. iii., p. 5 (pref. May). Australia = South West Australia. Figd. Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xi., p. 24, pl. vi., figs. 1-4.
1889. *Helicarion thomsoni* Ancey, Le Naturaliste, 1889, p. 19. Geographe Bay, South West Australia.
South Western Australia.

Genus PARMACOCHLEA Smith, 1884.

1884. *Parmacochlea* Smith, Proc. Zool. Soc. (Lond.), 1884, p. 273, October 1. Haplotype, *P. fischeri* Smith.

PARMACOCHLEA FISCHERI Smith, 1884.

1884. *Parmacochlea fischeri* Smith, Proc. Zool. Soc. (Lond.), 1884, p. 273, pl. xxiii., figs. 15, 15a, October 1. Cape York, Queensland.
North Queensland (Cape York district).

PARMACOCHLEA SMITHI Simroth, 1898.

1898. *Parmacochlea smithi* Simroth, Zool. Jahrbuch., Vol. xi., p. 158, pl. xv., figs. 1-10. Cooktown, North Queensland (Micholitz).
North Queensland (Cooktown district).

Note.—This species is based on anatomical details and could not have been separated by conchological data, so that many species may still be confused in collections from Queensland.

PARMACOCHLEA SEMONI Martens, 1894.

1894. *Helicarion semoni* Martens, Denksch. Med. Nat. Gesell., Jena, Bd. viii. (Zool. Forschr. Austr. (Semon), Bd. v.), Moll., p. 87, pl. iv., fig. 8. Burnett River, South Queensland.
South Queensland.

Family CYSTOPELTIDAE.

The genus *Cystopelta* has been referred to the family Flammulinidae, and also to the Helicarionidae; such diverse attempts to locate the genus necessitates the introduction of a family to cover such an extraordinary form. It provides an interesting corollary to the importance of anatomical features, as the anatomy is well known. It is here placed alongside the family Helicarionidae as being the most suitable association.

Genus CYSTOPELTA Tate, 1881.

1881. *Cystopelta* Tate, Papers Proc. Roy. Soc. Tasm., 1880, p. 17 (ante March 30, 1881). Haplotype, *C. petterdi* Tate.

CYSTOPELTA PETTERDI Tate, 1881.

1881. *Cystopelta petterdi* Tate, Papers Proc. Roy. Soc. Tasm., 1880, p. 17 (ante March 30, 1881). Near Launceston, Tasmania (Petterd).
North Tasmania.

CYSTOPELTA BICOLOR Petterd & Hedley, 1909.

1909. *Cystopelta bicolor* Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 293, August 30. Magnet Range and Upper Pieman River, Tasmania.
Tasmania.

CYSTOPELTA PURPUREA Davies, 1912.

1912. *Cystopelta petterdi* var. *purpurea* Davies, Proc. Roy. Soc. Vict., Vol. xxiv. (n.s.), pp. 331-342, pls. lxiv.-lxix., March. Narbethong, Victoria.
Victoria.

CYSTOPELTA ASTRA *sp. nov.*

1890. *Cystopelta petterdi* Hedley, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. v., pp. 44-46, pl. i., June 16. Mt. Kosciusko, N.S.W.
New South Wales.

Note.—A species of *Cystopelta* has been found as far north in New South Wales as Barrington Tops, and may even exist farther north still. At the place quoted Hedley noted the differences from the typical species, and since then two different species have been described from intervening localities.

Family DURGELLIDAE.

Thiele's Handbook was not available to me when I wrote upon *Sitala,* and I now find that Thiele had located the Australian *"Sitala"* under *Durgellina,* citing Odhner's anatomical details in that connection. Further study shows that the species previously referred to *"Sitala"* are obviously not congeneric, and perhaps more than one family is represented.

The type of *Durgellina* Thiele (Zool. Jahrb. (Jena), Syst., Vol. 55, p. 135, April 25, 1928) is *D. vitrina,* from the Bismarck Archipelago, a shell conchologically resembling the southern *Turrisitala* more than the North Queensland species, so that it would be unwise to introduce another alien name into our classification. The East Australian species are therefore divided according to their conchological features, and, in addition to *Turrisitala,* it is necessary to add *Sodaleta* with *Helix russelli* Brazier, as type; *Nevelasta* with *Helix pampini* Cox, as type; and *Eclipsena* with *Helix elleryi* Brazier, as type.

Genus TURRISITALA Iredale, 1933.

1933. *Turrisitala* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Helix turriculata* Cox = *T. normalis* Iredale.

TURRISITALA NORMALIS Iredale, 1933.

1933. *Turrisitala normalis* Iredale, Rec. Austr. Mus., Vol. xix., p. 56, August 2. New name for

1868. *Helix turriculata* Cox, Mon. Austr. Land Shells, p. 8, pl. viii., fig. 11, May. Miriam Vale, Port Curtis, Queensland (Blomfield). Refigd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 263, pl. viii., figs. 43-45, 1912. Not *Helix turriculata* Fischer, Oryct. Moscow, 1830.
South Queensland.

TURRISITALA WILDIANA *sp. nov.*
(Plate i., fig. 12.)

Shell larger and more sharply keeled, recalling *elleryi* in form, but differing entirely in sculpture, fine radials being present and concentric lirae absent. Height, 4.25 mm.; diameter, 3.5 mm. Cooktown, Queensland.
North Queensland.

TURRISITALA PARRAMATTENSIS Cox, 1864.

1864. *Helix parramattensis* Cox, Cat. Austr. Land Shells, p. 20. Parramatta, New South Wales (R. L. King). Figd. Cox, Mon. Austr. Land Shells, p. 8, pl. vi., fig. 10, May, 1868.
New South Wales.

Genus Sodaleta *nov.*

Type, *Helix russelli* Brazier.

Shell small, thin, glassy, broadly conical, base convex, umbilicus narrow, columella sloping, reflected, outer lip thin, mouth squarish, apical whorls flattened, sculpture fine, close radial striae.

Sodaleta russelli Brazier, 1875.

1875. *Helix (Conulus) russelli* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 668, pl. 83, figs. 13-14, April 1, 1875; Trans. Roy. Soc. N.S.W., Vol. viii., 1874, p. 29, 1875. Fitzroy Island, North Queensland.
North Queensland.

Sodaleta reedei Brazier, 1875.

1876. *Helix (Conulus) reedei* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 101, July. Darnley Island, Torres Strait. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 20, pl. iii., fig. 45, 1902.
North Queensland (Torres Straits' Islands).

Sodaleta barnardensis Brazier, 1876.

1876. *Helix (Conulus) barnardensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 101, July. Barnard Is., No. 3, Queensland. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 21, pl. iii., fig. 44, 1902.
North Queensland.

Sodaleta darnleyensis Brazier, 1876.

1876. *Helix (Conulus) darnleyensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 102, July. Darnley Is., Torres Straits. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 21, pl. iii., fig. 43, 1902.
North Queensland (Torres Straits' Islands).

Sodaleta nepeanensis Brazier, 1876.

1876. *Helix (Conulus) nepeanensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 102, July. Nepean Is., Torres Strait. Figd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxvii., p. 20, pl. iii., figs. 40-42, 1902.
North Queensland (Torres Straits' Islands).

Sodaleta umbraculorum Cox, 1864.

1864. *Helix umbraculorum* Cox, Cat. Austr. Land Shells, Add. No. 136. Clarence River, New South Wales (Macgillivray).
1865. *Helix wilcoxi* Cox, Proc. Zool. Soc. (Lond.), 1864, p. 595, May 2, 1865. Clarence River, New South Wales (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 9, pl. iv., fig. 12, May, 1868.
New South Wales.

Sodaleta kempseyensis Cox, 1872.

1872. *Helix kempseyensis* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 645, pl. 52, fig. 6, May 2, 1872. East Kempsey, Macleay River, N.S.W.
New South Wales.

Sodaleta microcosmos Cox, 1868.

1868. *Helix microcosmos* Cox, Mon. Austr. Land Shells, p. 3, pl. viii., fig. 12, May. New name for

1864. *Helix microscopica* Cox, Cat. Austr. Land Shells, p. 21. Stroud, New South Wales (Rev. R. L. King). Not *H. microscopica* Krauss, Südafr. Moll., p. 76, 1848.
New South Wales.

SODALETA SCANDENS COX, 1872.

1872. *Helix scandens* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 645, pl. 52, fig. 5, May 2, 1872. Port Macquarie, New South Wales.

1905. *Sitala pudica* Gude, Journ. Malac., Vol. xii., p. 11, pl. iii., figs. 3a-b., April 7. Cape Byron, Byron Bay, New South Wales.
New South Wales.

Note.—The original figure of *H. scandens* Cox is poor, but an authentic cotype proves it to be identical with *Sitala pudica* of Gude, and not referable to *Hedleyoconcha,* where I located it. This leaves the species Cox called *conoidea* and *fenestrata,* as shown in my synonymy, nameless, and I therefore propose *Hedleyoconcha duona* sp. nov. The shell resembles the Queensland *H. delta* in general features, but is broader basally, the umbilicus less open and the sculpture weaker, the type from Terrigal, near Gosford, N.S.W., measuring 9 mm. in breadth by 7 mm. in height. Pl. i., fig. 13.

While investigating this confusion some shells were found which had been collected by C. T. Musson. "In scrubs, arboreal; scarce. North Pine River, South Queensland", and regarded by him as a novelty. Hedley, however, determined them as *Thalassia delta* Pfeiffer, and they were so recorded (Proc. Linn. Soc. N.S.W., Ser. 2, Vol. vi., 1891, p. 553, May 23, 1892). Upon critical examination they prove to be very distinct as Musson first decided, and belong to no known genus, while their family association is doubtful.

The shell is small, conical, but with the apical whorls flattened and boldly spirally lirate, which separates them at sight from *Hedleyoconcha.* The adult sculpture is also unlike that of *Hedleyoconcha,* the reticulation seen in that genus being missing. I therefore propose the new generic name *Mussonula,* as a token of remembrance to that fine conchologist, C. T. Musson, who discovered and recognised it. The apical first whorl and a half is flattened, spirally lirate, the succeeding three whorls radially ridged, the ridges being numerous and close together, the interstices plain; the mouth is squarish, the columella straight, little reflected, the outer lip thin and sharp, the umbilicus open, narrow and deep. Breadth, 6.5 mm.; height, 5 mm. Pl. i., fig. 11.

The specific name will be *verax,* and after careful consideration, *Mussonula verax* may be placed in the family Laomidae, as an elevated relative of *Paralaoma.*

Genus NEVELASTA *nov.*

Type, *Helix pampini* Cox.

Shell small, globosely sub-conical, thin, pellucid, whorls few, rounded, mouth large, lips thin, columella a little twisted, reflected, covering umbilicus, a slight chink only remaining, sculpture very fine.

NEVELASTA PAMPINI COX, 1868.

1868. *Helix* (*Conulus*) *pampini* Cox, Mon. Austr. Land Shells, add. p. 111, pl. xix., figs. 9-9a, after May. Wide Bay, Queensland (Masters).
South Queensland.

NEVELASTA LIARDETI Brazier, 1872.

1872. *Helix (Conulus) liardeti* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 618, November 3. Picton, New South Wales (Liardet).
New South Wales.

Genus ECLIPSENA *nov.*

Type, *Helix elleryi* Brazier.

Shell small, thin, elevated conical, base flattened, practically no umbilical chink, columella straight, reflected, outer lip thin, mouth squarish, apical whorls flattened, adult whorls sculptured with fine regular concentric lirae.

ECLIPSENA ELLERYI Brazier, 1875.

1875. *Helix (Conulus) elleryi* Brazier, Proc. Zool. Soc. (Lond.), 1874, p. 668, pl. 83, figs. 3-4, April 1, 1875; Trans. Roy. Soc. N.S.W., Vol. viii., 1874, p. 29, 1875. Fitzroy Island, North Queensland.
North Queensland.

Family ANOGLYPTIDAE.

In his Handbuch, Thiele admitted a Stirps Acavacea, which included six families, Dorcasiidae, Acavidae, Clavatoridae, Caryodidae, Strophochilidae and Macrocyclidae. Such an aggregation defies all natural laws, and its artificiality dooms it to elimination. The Australian element, the family Caryodidae, is in itself an association of dissimilar forms without phyletic union, and of heterogeneous origin. Four distinct groups, apparently unrelated, are separable, and each are here given family rank.

The single species, *Anoglypta launcestonensis*, of the first family, is a conical umbilicate Helicoid with curious sculpture above, and smooth below, unlike any other living shell, but there is an extinct form, *Helix tasmaniensis* Sowerby (Phys. descr. New South Wales (Strzelecki), p. 298, 1845), which may be ancestral.

Genus ANOGLYPTA Martens, 1861.

1861. *Anoglypta* Martens, Die Heliceen (Albers), ed. 2, p. 312. Haplotype, *Helix launcestonensis* Reeve.

ANOGLYPTA LAUNCESTONENSIS Reeve, 1853.

1853. *Helix launcestonensis* Reeve, Conch. Icon., Vol. vii., pl. 149, sp. 968, February. Proc. Zool. Soc. (Lond.), 1852, p. 31, Moll., pl. xiii., figs. 11a-c, November 4, 1853. Launceston, Van Diemen's Land.
North Tasmania.

Family CARYODIDAE.

An extraordinary elongate pseudo-Bulimoid from Tasmania has been associated with the preceding on account of its living in Tasmania and laying large eggs! As this form is so peculiar all the races or species have been lumped under one specific name, so that research is necessary to determine accurately the status of the observed variations. Tenison-Woods (Proc. Linn. Soc. N.S.W., Vol. iii., pp. 81-91, pl. vii., December, 1878) discussed the matter nearly sixty years ago.

Genus CARYODES Albers, 1850.

1850. *Caryodes* Albers, Die Heliceen, 1st ed., p. 141, August. Haplotype, *Bulimus dufresnii* Leach.

CARYODES DUFRESNII Leach, 1815.

1815. *Bulimus dufresnii* Leach, Miscell. Zool., Vol. ii., p. 153, pl. cxx. (end of 1815, acknd. January 11, 1816). New Holland, restricted locality; north of Hobart, Tasmania.
Tasmania.

Note.—Tenison-Woods noted that the varieties were more or less localised and gave illustrations of the variation. Thus, from Macquarie Harbour, he recognised a large shell, broad, deep maroon (pl. vii., fig. 4), but also small light yellow shells (pl. vii., fig. 7). The differences may be due to altitude; the large broad shell is here named *Caryodes dufresnii superior* subsp. nov., as names are necessary. Port Davey shells were figured as large and narrow with the columella nearly straight (pl. vii., fig. 3); these may be called *Caryodes dufresnii extra* subsp. nov.

In the north, at Ringarooma, a large narrowly elongate form occurs of a chestnut brown coloration (pl. vii., fig. 6), but at Launceston the shells are smaller, though elongate in shape, and with the columella notably twisted (pl. vii., fig. 2). The cause of variation here needs local investigation, but the Launceston form is distinguished as *Caryodes dufresnii dertra* subsp. nov. It is possible that some of the forms are separable specially, and thus the discrepant records may be co-ordinated.

Family PEDINOGYRIDAE.

Associated with *Caryodes*, because both lay large eggs, the huge flattened Helicoids are discordant in shell form as much as any shells can be. Such an unnatural grouping is difficult for any normal student to understand.

Under *Pedinogyra* only one species has been sometimes allowed, and two have been the most hitherto recognised. The great difficulty in distinguishing the species at present is the carelessness of early workers' labelling. Using fresh material, five species, and probably many subspecies, may be determined, but more collections are necessary in the latter case. However, the five species here distinguished are well marked and constant.

Shell of medium size, subkeeled at the periphery, brown above, banded, umbilical cavity yellow .. .. *hayii.*
Shell much larger, still subkeeled peripherally, uniformly pale above and below, last whorl flattened below .. .. *allani.*
Shell still larger and paler, umbilicus wider, but last whorl rounded below .. .. *allani ultra.*
Shell small, elevated, dark colour above, umbilical cavity yellow, no peripheral keeling .. .. *nanna.*
Shell a little larger than the preceding, dark colour above and below, umbilical cavity dark, no peripheral keeling .. .. *effossa.*
Shell small, dark coloured above and below, peripheral keel prominent .. .. *rotabilis.*

PEDINOGYRA HAYII Griffith & Pidgeon, 1833.
(Plate i., figs. 1, 2.)

1833. *Helix hayii* Griffith & Pidgeon, Animal Kingdom (Cuvier), Vol. xii., Moll., pl. 36, fig. 4. No locality = Hay's Peak, Moreton Bay = Toowoomba, S. Queensland.

1834. *Helix cunninghami* Griffith & Pidgeon, Animal Kingdom (Cuvier), Vol. xii., Moll., pl. 36*, fig. 4, ex Gray MS. Same drawing corrected. Index, p. 597, as of Gray.

1834. *Helix cunninghami* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 64, November 25, cites "Griff. Anim. Kingd., t. 6, fig. 4". Hay's Peak, near Brisbane, Queensland (Allan Cunningham).

1838. *Helix tupinierii* Eydoux, Mag. de Zool., 1838, pl. 114. "Manilla" error = Sydney, i.e., Toowoomba, Queensland.
South Queensland.

Note.—When Allan Cunningham collected this species at Hay's Peak, which was named in honour of R. W. Hay, Under Secretary of State for the Colonies, he probably signified his desire that this fine shell should also be named for Hay. This was done, and a plate was issued in the Animal Kingdom (Cuvier), prepared by Griffith and Pidgeon, bearing this name. The plate No. 36, was issued in 1833, but unfortunately the shells were reversed in the printing. A corrected plate was given the following year, numbered 36*, and on this the name was altered to *Helix cunninghami*, and in the Index, published later still, the name was credited to Gray. In most copies the corrected plate only now appears, the printer's instruction, for the destruction of the earlier plate, being faithfully followed, but in the Australian Museum there is a copy with the original plate. In this copy there are also other plates originally reversed, but later corrected, but in no other case is there any alteration of name.

Typical shells are brown above banded with darker brown, the subperipheral colouring being darker brown, the umbilical cavity contrasting straw yellow. The periphery shows a keel which disappears on the last half whorl, and the outer lip is dark coloured and strongly thickened. A norm measures 70 mm. in diameter, and 25 mm. in height.

PEDINOGYRA ALLANI *sp. nov.*

(Plate i., figs. 7, 8.)

Shells from Port Curtis are larger, straw coloured above and below, the umbilical cavity brighter, the subperipheral band a little darker, the mouth having the outer lips thickened, but white, the base of the last whorl flattened. This was figured by Cox (Mon. Austr. Land Shells, pl. i., fig. 5), who had commented seventy odd years ago, "Capable of being made a new species", advice for some unknown reason not followed. A still larger shell from the North Pine River is similarly coloured, but has the base of the last whorl more rounded and the umbilicus wider. This reaches 94 mm. in diameter, and 30 mm. in height, and may be called *P. allani ultra* subsp. nov., the typical *allani* measuring 80 mm. in diameter, and 28 mm. in height.

PEDINOGYRA NANNA *sp. nov.*

(Plate i., figs. 9, 10.)

1869. *Helix cunninghami* var. *minor* Mousson, Journ. de Conch., Vol. xvii., p. 60, January 1. Rockhampton, Queensland (Frau Dietrich).

When Cox prepared his first list he also recognised the distinction of this form, which Mousson named as a variety only. Many specimens show it to be very different, the lack of any peripheral keel being notable, the small size, the distinct coloration, and the strongly thickened white lip confirming the specific status of this form, which measures only 50 mm. in diameter, and 22 mm. in height.

PEDINOGYRA EFFOSSA *sp. nov.*

(Plate i., figs. 3, 4.)

Shells from Bundaberg, Queensland, provided another surprise as, resembling *nanna* in shape, they are larger, with the base more excavate, the

huge umbilical cavity all dark coloured, and the lips only slightly thickened; in these features recalling *rotabilis*, but that species has a strong peripheral keel, while this has no signs of a keel. It measures 65 mm. in diameter, and 25 mm. in height, and may be Cox's MS. var. *excavata*, which he localised as from Port Denison, where this genus does not occur—but only as a *nomen nudum*.

PEDINOGYRA ROTABILIS Reeve, 1852.

1852. *Helix rotabilis* Reeve, Conch. Icon., Vol. vii., Helix, pl. 70, sp. 361, January. "Australia" = Richmond River, N.S.W.

1852. *Helix muhlfeldtiana* Reeve, Conch. Icon., Vol. vii., Helix, text to pl. 70, sp. 361, January, ex Pfeiffer MS. in synonymy. Not *H. muhlfeldtiana* Pfeiffer, Mon. Helix, Vol. i., p. 169, 1848, ex Ziegler MS.

1854. *Helix muhlfeldtiana* Pfeiffer, Proc. Zool. Soc. (Lond.), 1852, p. 156, June 27, 1854.. Australia.

1869. *Helix cunninghami* var. *compressa* Mousson, Journ. de Conch., Vol. xvii., p. 60, January 1. Australia (Rietman). Not *H. compressa* Rossmässler, Icones L. and S., Moll. Europ., i. (3), p. 2, March, 1836. Northern New South Wales. South Queensland.

Note.—Although this has commonly been known as *muhlfeldtiana*, sometimes as a species, at others a variety only, it will be seen from the synonymy that name has no right at all. Richmond River is selected as the type locality, and Cox remarked that the Clarence River shells were larger, but this is not confirmed by the series available. A number from Canungera, South Queensland, however, are smaller, more elevated, very dark in colouration, with the outer lip whitish. These may be called *P. rotabilis elsa* subsp. nov., the type measuring 47 mm. in diameter, and 23 mm. in height, the Richmond River shells reaching 65 mm. by only 24 mm. Pl. i., figs. 5, 6.

Family HEDLEYELLIDAE.

This delightful series of molluscs, apparently closely allied, ranges from very large, almost globular imperforate or widely umbilicate, shells to a small ear-shaped thin degenerate form. This group is confined to Eastern Australia, the smallest shell living at Mackay, Mid-Queensland, another small one at the boundary of New South Wales and Victoria, but both very large and small species occurring together in their stronghold, the Oxleyan Sub Area.

Genus HEDLEYELLA Iredale, 1914.

1914. *Hedleyella* Iredale, Proc. Malac. Soc. (Lond.), Vol. xi., p. 174, September. New name for

1861. *Panda* Albers, Die Heliceen, ed. 2 (Martens), p. 149. Orthotype, *Helix falconari* Reeve = Gray. Not *Panda* Van Heyden, Isis. (Oken), 1826, col. 612.

HEDLEYELLA FALCONERI Gray, 1834.

1834. *Helicophanta falconeri* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 63, November 25, ex Reeve MS. New Zealand = "70,000 paces from Fort Macquarie" = Hunter River, N.S.W. Figd. Reeve, Conch. Syst., Vol. ii., p. 69, pl. 163, fig. 4, 1841.

1846. *Helix infundibulum* Valenciennes, Voy. Venus, Atlas, Tabl., pl. and Moll., pl. i. No locality = Hunter River, N.S.W. Not *H. infundibulum* Hombron & Jacquinot, Ann. Sci. Nat. (Paris), Vol. xvi., p. 64, 1841.

1892. *Panda falconeri* vars. *azonata* and *tigris* Hedley, Rec. Austr. Mus., Vol. ii., p. 31, August, colour varieties only = Hunter River, New South Wales.
1933. *Hedleyella falconeri jacksoniana* Iredale, Rec. Austr. Mus., Vol. xix., p. 38, August 2. Booyong, Richmond River, New South Wales (S. W. Jackson).
1933. *Hedleyella falconeri imitator* Iredale, Rec. Austr. Mus., Vol. xix., p. 38, August 2. South Queensland.
Northern New South Wales. South Queensland.

HEDLEYELLA MACONELLI Reeve, 1853.

1853. *Bulimus maconelli* Reeve, Proc. Zool. Soc. (Lond.), 1851, p. 198, Moll., pl. xii., June 29, 1853, ex Brown MS. Brisbane, Moreton Bay, Australia.
1853. *Bulimus maconnelli* Pfeiffer, Mon. Helic., viv., Vol. iii., p. 380, ex Reeve (pref. May), on same specimen.
South Queensland.

Genus PYGMIPANDA Iredale, 1933.

1933. *Pygmipanda* Iredale, Rec. Austr. Mus., Vol. xix., p. 39, August 2. Orthotype, *Bulimus atomatus* Gray.

PYGMIPANDA ATOMATA Gray, 1834.

1834. *Bulimus atomatus* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 64, November 25. "Near Fort Macquarie, New South Wales" = Hunter River, New South Wales. Figd. Cox, Mon. Austr. Land Shells, p. 71, pl. xiii., fig. 8; pl. xviii., fig. 15, May, 1868.
1892. *Panda atomata* vars. *elongata* and *azonata* Hedley, Rec. Austr. Mus., Vol. ii., p. 31, August, colour varieties only = Hunter River, New South Wales.
Northern New South Wales.

PYGMIPANDA KERSHAWI Brazier, 1872.

1872. *Bulimus* (*Liparus*) *kershawi* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 641, May 2, 1872. Snowy River, Gippsland, Victoria. Figd. Hedley, Rec. Austr. Mus., Vol. ii., p. 31, pl. v., fig. 9, August, 1892. Refigd. Gabriel, Proc. Roy. Soc. Vict., Vol. xliii. (n.s.), p. 66, pl. iii., figs. 1-8, 1930.
Southern New South Wales. Victoria.

The New South Wales form is smaller and less elongate, the spire being short, the type is from Moonbar, Mt. Kosciusko, and measures 40 mm. in height and 28 mm. in breadth, and is here named *P. kershawi divulsa* subsp. nov.

Genus BRAZIERESTA Iredale, 1933.

1933. *Brazieresta* Iredale, Rec. Austr. Mus., Vol. xix., p. 39, August 2. Orthotype, *Bulimus larreyi* Brazier.

BRAZIERESTA LARREYI Brazier, 1871.

1871. *Bulimus larreyi* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 321, August 16. Bellengen River, New South Wales. Figd. Cox, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. ii., p. 1062, 1887 (with animal).
Northern New South Wales.

Genus Pandofella Iredale, 1933.

1933. *Pandofella* Iredale, Rec. Austr. Mus., Vol. xix., p. 39, August 2. Orthotype, *Panda whitei* Hedley.

Pandofella whitei Hedley, 1912.

1912. *Panda whitei* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 254, pl. iv., figs. 1-4, December 13. Near Mackay, North Queensland (S. W. Jackson).
Mid Queensland (Mackay district).

Superfamily Helicoidea.

The Helicid shells must be divided into many families, and the superfamily in Australia alone is represented by distinct series of forms here regarded as families. Thus the *Hadra-Sphaerospira-Meridolum* aggregation is separable from the *Xanthomelon* group, but the allocation of some of the minor series is not easy. The present grouping is tentative, but some attempt must be made to introduce order into the great Helicoid accumulation. Anatomical features will assist, but these must be utilised with caution as in the past their misunderstanding has led to confusion. This can be seen in connection with the Centralian shells dissected by Hedley. Using anatomical details he separated two groups, which he called *Xanthomelon* and *Thersites,* and then allotted the species according to these criteria, and the last state was worse than the first. Shells so similar that they conchologically appeared closely allied were widely dissevered.

Family Hadridae.

This family will include the Australian Helicid species, which were referred by Pilsbry years ago to a section of his conglomerate genus *Helix.* To-day it is difficult even to limit the family, as the shell features become modified in many ways, so that members mimic shells referable to other groups and thus confuse superficial observers. Consequently the present arrangement must be regarded as purely tentative, but some basis must be provided to group the species so that order may come out of the chaos at present existing.

Genus Hadra Albers, 1861.

1861. *Hadra* Albers, Die Heliceen, 2nd ed. (Martens), pp. xiv., 165. Orthotype, *Helix bipartita* Férussac.

The extraordinary variation in size and form in this group has been a source of trouble for local conchologists who attempted to separate the species, using their special knowledge of the actual living conditions. Comparatively recently a learned American authority made an attack—without these safeguards—and his conclusions are tragical. About nine species with an additional eighteen subspecies were distinguished of which very few have any reality. As he ignored published accounts of students such as Brazier and Pace, his localities and forms become so complex as almost to defy correction. Thus he makes Lizard Island the type locality of *forsteriana*, and adds also a subspecies from the same locality, although Brazier had correctly stated that *forsteriana* did not occur on Lizard Island. He then figured as a form of a new species, *lizardensis,* a shell exactly agreeing with the type of *semicastanea* as early recognised by Brazier. Marshall also differentiated the unicolor shell from Murray Island as a distinct species, whereas it is merely a colour variation, even as Pace had

recorded in connection with *bipartita* from the Cape York district. It is very difficult to offer any satisfactory subdivision at present, but it is believed that geographical considerations will prove paramount. If that prove true some of Marshall's names will become available, but many more will also be necessary, as the colonies on each islet appear to differ a little, but individual shells cannot be accurately determined. Therefore here an arbitrary division is put forward as a temporary expedient. The mainland large shells with rounded periphery are regarded as *bipartita,* the southern keeled form as *webbi,* the island large shell from Lizard Island to Cape York as *semicastanea,* while the Torres Strait shells may be called *bartschi,* a small Torres Strait shell being named *funiculata,* and the small southern island series *forsteriana.*

HADRA BIPARTITA Férussac, 1822.

1822. *Helix bipartita* Férussac, Hist. Moll., livr. 17, pl. 75, A., figs. 1-2. Australia = Cooktown, North Queensland.
1825. *Helix bipartita* Gray, Annals Philos. (Thomson), n.s., Vol. ix. (Vol. xxv.), p. 410, June, based on Férussac's plate (which must have been published earlier *with name*).
[1861. *Helix (Hadra) semibadia* Albers, Die Heliceen, 2nd ed. (Martens), p. 165. Philippine Islands. *Nomen nudum.*
1868. *Helix semibadia* Pfeiffer, Mon. Helic., viv., Vol. v., p. 320, for a variety of *Helix bipartita* "peristomate fusculo"; no such variety is known so that this name is indeterminate; the locality cited by Albers suggests an extralimital shell.]
North Queensland (Cape York to Cooktown).

At the early date of the description of this species Cooktown seems the only place whence this shell could have been received. Férussac's figures agrees very closely with specimens collected at that locality. From the Cape York area Pace (Proc. Mal. Soc. (Lond.), Vol. iv., p. 205, 1901), recorded two colonies, a pale unicolor variety in the scrub at Somerset, while at Vallack Point the shells were all bicolor, but no other differences were recorded as the shape and size were so variable. Pilsbry (Man. Conch. (Tryon), Ser. ii., Vol. vi., p. 126, August 12, 1890), figured a shell (pl. 21, fig. 44), measuring 26 mm. in height by 31 mm. in breadth as a var. *minor,* which may belong to the *semicastanea* series, no locality being given for it. Later (op. cit., Vol. viii., p. 276, July 1, 1893), Pilsbry wrote, "Dr. Cox proposes to call the unicolored yellow form of this species var. *unicolor*". Pace gave the measurements of the unicolor shell as height, 45-59 mm., breadth 58-63 mm. Shells collected at Cook's landing place at Cooktown provide very similar measurements, a smaller specimen agreeing almost exactly with Férussac's figure.

HADRA WEBBI Pilsbry, 1900.

1900. *Thersites webbi* Pilsbry, Proc. Acad. Nat. Sci. Philad., 1899, p. 473, figs. 1-2 in text, January 11, 1900. ? Northern Queensland = Cairns district.
1933. *Hadra webbi incallida* Iredale, Rec. Austr. Mus., Vol. xix., p. 43, August 2. Atherton Tableland, North Queensland. Pl. ii., fig. 1.
North Queensland (Cairns district).

HADRA SEMICASTANEA Pfeiffer, 1849.

1849. *Helix semicastanea* Pfeiffer, Zeitschr. für Malak., Vol. vi., p. 77, November, cites "'Chemn., ed. 2, Helix, 319, t. 56, figs. 3-5" (query pub-

lished). Nova Hollandia ? = Lizard Island, North Queensland.

1927. *Thersites (Hadra) lizardensis lizardensis* Marshall, Proc. U.S. Nat. Mus., Vol. 72, Art. 15, p. 4, pl. 2, fig. 7. Lizard Island.

1927. *Thersites (Hadra) lizardensis rada* Marshall, loc. cit., p. 5, pl. ii., fig. 4. Lizard Island (agrees very closely with Pfeiffer's original figure above cited).

1927. *Thersites (Hadra) semicastanea semicastanea* Marshall, loc. cit., p. 6, pl. ii., fig. 5. (Doubtfully associated here).

1927. *Thersites (Hadra) semicastanea alma* Marshall, loc. cit., p. 7, pl. iii., fig. 8. "Cape York, Queensland". Locality probably incorrect. North Queensland (Islands from Lizard Island northwards).

Note.—Macgillivray pointed out that specimens from the peak of Lizard Island were very large and thin, living under stones; on the lower parts of the island, a smaller, stouter, and brightly coloured, but variable, form was abundant living in the scrubs, about the roots of trees and among dead leaves; while on a mound-like rocky islet, a couple of hundred yards from the shore, there lived a small, dull, solid variety, not exceeding an inch in diameter. Hedley collected a couple of specimens at Restoration Island, which are large for the *semicastanea* series and are more like *bipartita*. One is elevated, the other somewhat depressed, but both agree in their very large size for island shells, and they may be called *blighi* (Pl. ii., fig. 2), to recall that Captain Bligh, of the Mutiny of the Bounty fame, was always interested in shells. Restoration Island was the place Bligh first touched on the Australian coast in his historic struggle, after the Mutiny, to reach Timor.

HADRA BARTSCHI Marshall, 1927.

1927. *Thersites (Hadra) bartschi bartschi* Marshall, Proc. U.S. Nat. Mus., Vol. 72, Art. 15, p. 8, pl. ii., fig. 1. Darnley Island, Torres Strait.

1927. *Thersites (Hadra) bartschi mobiagensis* Marshall, *loc. cit.*, p. 8, pl. i., fig. 1. Mobiag. Island, Torres Strait.

1927. *Thersites (Hadra) bartschi yamensis* Marshall, *loc. cit.*, p. 8, pl. i., fig. 4. Yam Island, Torres Strait.

1927. *Thersites (Hadra) bartschi oma* Marshall, *loc. cit.*, p. 9, pl. iii., fig. 2. Yam Island, Torres Strait.

1927. *Thersites (Hadra) bartschi nura* Marshall, *loc. cit.*, p. 9, pl. iii., fig. 7. Yam Island, Torres Strait.

1927. *Thersites (Hadra) bartschi nesia* Marshall, *loc. cit.*, p. 10, pl. iii., fig. 5. Yam Island, Torres Strait.

1927. *Thersites (Hadra) bartschi paulensis* Marshall, *loc. cit.*, p. 10, pl. iii., fig. 10. St. Paul's Island, Torres Strait.

1927. *Thersites (Hadra) bartschi murrayensis* Marshall, *loc. cit.*, p. 11, pl. i., fig. 5. Murray Island, Torres Strait.

1927. *Thersites (Hadra) bartschi fama* Marshall, *loc. cit.*, p. 11, pl. iii., fig. 9. Murray Island, Torres Strait.

1927. *Thersites (Hadra) bartschi elfa* Marshall, *loc. cit.*, p. 11, pl. iii., fig. 3. Murray Island, Torres Strait.

1927. *Thersites (Hadra) bartschi diva* Marshall, *loc. cit.*, p. 12, pl. ii., fig. 2. Murray Island, Torres Strait.

1927. *Thersites (Hadra) bartschi cepa* Marshall, *loc. cit.*, p. 12, pl. iii., fig. 1. Murray Island, Torres Strait.

1927. *Thersites (Hadra) waltoni* Marshall, *loc. cit.*, p. 12, pl. ii., fig. 3. Murray Island, Torres Strait.

1927. *Thersites* (*Hadra*) *dalli* Marshall, *loc. cit.*, p. 13, pl. ii., fig. 8. "North-east Australia" = Murray Island.
North Queensland (Islands in Torres Strait).

Note.—The shells from the islands in Torres Strait are very variable, and individuals cannot be allocated, although a series from each islet shows a similar facies. If these island colonies be named and ranked as sub-species, some of the names introduced by Marshall may be used. More island names will then become necessary as there are series from Nepean Island, which are bicolor, flattened, and merge into the Murray Island series, while the earliest known form is from Warrior Island. This was figured by Hombron and Jacquinot in the Voy. Pole Sud., Atlas, Moll., pl. iii., figs. 7, 8, 9, 1851, or earlier, as questionably *H. bipartita,* and may be called *Hadra* (*bartschi*) *quaesita* subsp. nov., as the specimens do not fall into any other island series. Shells are also known of this group from Mt. Cornwallis Island, very close to the New Guinea coast. It may be noted that Marshall recorded four forms from "Yam Island", but there is no such island on the map, and I am told that it is a local name for Yorke or Masig Island.

HADRA FUNICULATA Reeve, 1854.

1854. *Helix funiculata* Reeve, Conch. Icon., Vol. vii., Helix, pl. 194, sp. 1363, September, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 147, April 11, 1855). Islands in Torres Strait.
North Queensland (Stephens Island, Torres Strait).

The name was given to a small flattened keeled shell and has been used for many specimens from Stephens Island, which are, as usual, variable in shape, form and colouring, but are all small. No large ones have been seen from this island, otherwise the name would become valid for the Island shells which are here called *bartschi.*

Genus JACKSONENA *nov.*

Type, *Planispira rudis* Hedley.

The difference between the genera *Hadra* and *Planispira* is apparently of more than generic value, and I here allow them family distinction. Consequently a shell which was placed in *Planispira,* and I consider of Hadroid affinity requires generic nomination. The shell itself is of strange appearance, yet withal a beautiful form, and is one of the many novelties secured by that excellent collector and observer, Mr. Sidney W. Jackson, and I here dedicate the group to him.

The shell is subdiscoid, spire flattened, sutures not impressed, sculpture rough, mouth subangulate as the periphery is acutely keeled, the base convex, columella straight, umbilicus small, deep, open.

JACKSONENA RUDIS Hedley, 1912.

1912. *Planispira rudis* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 258, pl. vi., figs. 24-27, December 13. Tinaroo scrubs, S.W. of Cairns, Queensland.
North Queensland (Cairns district).

JACKSONENA DELICATA Hedley, 1912.

1912. *Planispira delicata* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 259, pl. vi., figs. 28-31, December 13. Belson's Scrub, Atherton, North Queensland.
North Queensland (Atherton district).

Genus Zyghelix *nov.*
Type, *Helix forsteriana* Reeve.

This little group is one of the most perplexing of all the Queensland series. The shells are of small size, rather depressed, granulosely obscurely sculptured, umbilicus small deep, open, the sloping reflected columella scarcely concealing part of it, coloration pale fawn with reddish concentric bands.

The coloration distinguishes this group, which is mainly represented on the islands off the north coast of Queensland from Cooktown to the Howick Islands, but which also occurs on the mainland adjacent, and thence southward to Cairns. The variation seems to be geographical and colonial, but the forms are not nominated here, the material being insufficient.

Zyghelix forsteriana Reeve, 1852.

1852. *Helix forsteriana* Reeve, Conch. Icon., Vol. vii., pl. 182, sp. 439, March, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1851, p. 254, July 26, 1853). North Australia.
1854. *Helix forsteriana* Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. i., heft. xii., p. 373, pl. 140, figs. 9-10.
1860. *Helix hetaera* Pfeiffer, Proc. Zool. Soc. (Lond.), 1860, p. 134, June. Locality unknown.
1862. *Helix forsteriana* var. *major* Dohrn, Malak. Blatt., Vol. vi., p. 210, dated November. *Nomen nudum.*
[*Helix forsteriana major* Pfeiffer, Mon. Helic., viv., Vol. iv., p. 174, 1859.
Helix forsteriana major Pfeiffer, Mon. Helic., viv., Vol. v., p. 377, 1866.
Helix forsteriana major Dohrn, Conch. Cab., pl. 171, figs. 8-10, 1879.
These names quoted by Marshall, *loc. cit.*, p. 15, do *not* occur.]
1927. *Thersite* (sic) (*Hadra*) *forsteriana forsteriana* Marshall, Proc. U.S. Nat. Mus., Vol. 72, Art. 15, p. 14, pl. ii., fig. 6. "Lizard Island."
1927. *Thersites* (*Hadra*) *forsteriana major* Marshall, *ib.*, p. 15, pl. iii., fig. 6. "North-east Australia".
1927. *Thersites* (*Hadra*) *forsteriana ada* Marshall, *id. ib.*, p. 15, pl. iii., fig. 4. "Lizard Island".

The type locality of the original species must be determined. Dohrn (Malak. Blatt., Vol. vi., p. 210, 1862) discussed a series sent by Macgillivray separating them into three forms; the largest he named var. *major*, the medium sized ones he called *hetaera*, the smallest, 12-15 mm. in diameter, being regarded as typical. Cox (Mon. Austr. Land Shells, p. 42, pl. iv., fig. 8, May, 1868), published Macgillivray's data (unfortunately after the latter's death), stating that the largest came from Howick Islands, and the smallest from Percy Isles. The last-named locality was obviously incorrect, being well outside the range of this class of Helicoid. Brazier (Journ. de Conch., Vol. xxviii., p. 316, 1880) corrected the latter to Cape Sidmouth, having collected somewhat similar specimens in that locality, and pointed out that this species did *not* live on Lizard Island.

However, I have now Macgillivray's notebook before me, and he has there written:—Largest shells, Howick Isles, medium size, Rocky Island, and the smallest from Two Isles. Specimens from these localities, collected by Macgillivray, are in the Australian Museum.

Pfeiffer's type of *forsteriana* measured 20½ x 18 x 12 mm., and the Rocky Isle form is the one in agreement; *hetaera* was also measured as 19 x 16 x 10½ mm., thus falling as an absolute synonym. The small shells from

Two Isles measure 12-15 mm. in diameter, and the Howick Isles shells 24.5 x 21 x 17 mm. being the major form. Marshall's *ada* was very large, measuring 31 x 27 x 18 mm., but this is reached by a Howick Island shell, so that may be used. Shells from Three Isles are similar but a little larger than Two Isles ones, reaching 15-18 mm. in diameter. Specimens are also available from Flinder's Group, Barrow Island, Cape Sidmouth and the Cooktown district.

ZYGHELIX PRAEHADRA Odhner, 1917.

1917. *Planispira praehadra* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 97, pl. iii., figs. 101-103, September 19. Chillagoe Caves, North Queensland (subfossil).
North Queensland (Chillagoe Caves district, *living*).

Note.—This species was described as an extinct species from the Chillagoe Caves, but it is living in that locality, and is not unlike the *forsteriana* series.

ZYGHELIX DARWINI Brazier, 1872.

(Plate ii., fig. 8.)

1872. *Helix* (*Hadra*) *darwini* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 639, May 2, 1872. North coast of Australia.

The specimens described are now in the Australian Museum, and appear to be closely related to *forsteriana,* and to have come from somewhere north of Cape Sidmouth.

Genus SPURLINGIA Iredale, 1933.

1933. *Spurlingia* Iredale, Rec. Austr. Mus., Vol. xix., p. 47, August 2. Orthotype, *Helix nicomede* Brazier.

SPURLINGIA NICOMEDE Brazier, 1878.

1878. *Helix nicomede* Brazier, Proc. Linn. Soc. N.S.W., Vol. iii., p. 79, pl. 8, fig. 6, December. Cardwell, Queensland.
North Queensland.

SPURLINGIA DUNKIENSIS Forbes, 1851.

1851. *Helix dunkiensis* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 378, pl. ii., figs. 7a-b, "1852" = mid-December, 1851. Dunk Island, Queensland. Figd. Cox, Mon. Austr. Land Shells, p. 43, pl. viii., fig. 9, May, 1868.
North Queensland.

SPURLINGIA COXENAE Brazier, 1875.

1875. *Helix* (*Hadra*) *coxenae* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 32, pl. iv., fig. 5, June 1. Johnson (= Johnstone) River, Queensland.
North Queensland.

SPURLINGIA TINAROOENSIS *sp. nov.*

1912. *Thersites dunkiensis* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 255, pl. iv., figs. 5-8, December 13. Tinaroo, W. of Cairns, North Queensland.

This species is more obese than *dunkiensis,* measuring 35 mm. in breadth by 25 mm. in height, and has a wider umbilicus with a more pronounced sculpture. The forms of *Spurlingia* may only be of subspecific value, but at present that is not proven, and it will be better to allow them specific value.

North Queensland (Tinaroo district).

SPURLINGIA EXCELLENS *sp. nov.*
(Plate ii., fig. 9.)

Mr. W. D. Campbell sent a shell from Almaden, with the spire depressed, the umbilicus wider than in *dunkiensis,* the mouth smaller, the surface strongly concentrically grained with elongate grains; it measures 31 mm. in breadth and 19 mm. in height.

North Queensland (Almaden district).

SPURLINGIA CADMUS *sp. nov.*
(Plate ii., fig. 6.)

When introducing *nicomede* Brazier described two specimens from Gould (sic) Island. To these he had given the name *cadmus* in MS., and this name is used as this island form is smaller, comparatively more elevated with more rounded whorls. The measurements of the type read: breadth 34 mm., height 24 mm.

North Queensland (Goold Island).

SPURLINGIA HELGA *sp. nov.*
(Plate ii., fig. 4.)

The Hinchinbrook Island shell is still more elevated, an altitude of 28 mm. to the breadth of 34 mm.; the umbilicus is a little less, and the sculpture in this, as well as in the preceding, is much finer than in *dunkiensis,* although of exactly the same kind.

SPURLINGIA PORTUS *sp. nov.*
(Plate ii., fig. 5.)

A specimen from Port Douglas is larger than any of the preceding five, and is flat, a little more elevated than *excellens,* with the same rough sculpture, but with a smaller umbilicus and a larger mouth, measuring 38 mm. by 24 mm.

North Queensland (Port Douglas district).

SPURLINGIA GEMMA *sp. nov.*
(Plate ii., fig. 7.)

Shell smaller than *Zyghelix praehadra,* more elevated, whorls more rounded, and more tightly coiled, umbilicus narrow, open, deep, columella almost straight, scarcely reflected, sculpture of fine horizontal grains, referring it to this genus in preference to *Zyghelix,* where it was first placed. Measurements, 21 mm. in breadth; 15 mm. in height.

North Queensland (Chillagoe township).

Genus GNAROSOPHIA Iredale, 1933.

1933. *Gnarosophia* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. Orthotype, *Helix bellendenkerensis* Brazier.

GNAROSOPHIA BELLENDENKERENSIS Brazier, 1875.

1875. *Helix bellendenkerensis* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 32, pl. iv., fig. 4, June 1. Bellendenker Mountains, North Queensland.
North Queensland.

GNAROSOPHIA BEDDOMAE Brazier, 1878.

1878. *Helix beddomae* Brazier, Proc. Linn. Soc. N.S.W., Vol. iii., p. 80, pl. 8, fig. 6, December. Cardwell, Queensland.
North Queensland.

GNAROSOPHIA CASTANEA Odhner, 1917.

1917. *Thersites castanea* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 87, pl. iii., figs. 97-98, text-fig. 44, September 19. Cedar Creek, Bellendenker Mts., North Queensland.
North Queensland.

A series collected by Mr. S. W. Jackson at the Tinaroo Scrubs, S.W. of Cairns, are all small, elevated, dark, almost unicolor, and with the umbilicus almost closed. Another series are much larger, elevated, with the mouth expanded, as in the forms of *palmensis,* and consequently the umbilicus fairly open. These are from Innisfail, and the two series are quite distinct and separable from the type of *bellendenkerensis,* while *beddomae* is notable for its coloration, as well as form, and *castanea* is a smaller shell, apparently also separable. At present it seems best to allow these forms specific rank, as the geology of the territory wherein they live is complicated, and at Lake Barrine, on the tableland near Cairns, I found a juvenile of this genus living alongside one of true *Hadra.* This was interesting as *beddomae* has the coloration of the true *Hadra,* and might easily be regarded as a race only *"bipartita",* without special knowledge of its occurrence. While the Tinaroo Scrubs shell may be a form of *castanea,* the large Innisfail shell is here named *G. humoricola* sp. nov., pl. ii., fig. 17, the measurements of the type being 55 mm. in breadth by 45 mm. in height. It may be pointed out in connection with Brazier's measurements that he measured the altitude of the shell as placed on the table, not the vertical axis as we take it to-day. This accounts for the constant discrepancies noted in his figures.

GNAROSOPHIA MULGRAVENSIS Brazier, 1872.
(Plate ii., fig. 15.)

1872. *Helix (Camaena) mulgravensis* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 21, June 1. "'Mulgrave Island, Torres Strait". Error = Mulgrave River probably.

1889. *Helix mulgravei* Hedley, Proc. Roy. Soc. Queensland, Vol. vi., p. 101, ex Brazier MS. Emendation only.
North Queensland.

GNAROSOPHIA PALMENSIS Brazier, 1876.

1876. *Helix (Hadra) palmensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 105, July. Palm Isl. (= Great North Palm Island), North East Australia. Figd. Fulton, Journ. Malac., Vol. xi., p. 7, pl. i., figs. 5-6, April 25, 1904.

1881. *Helix palmensis* var. *meridionalis* Brazier, Proc. Linn. Soc. N.S.W., Vol. v., p. 458, February. Large South Palm Island, North East Australia. Not *Helix meridionalis* Wood, Suppl. Index Text, p. 23, 1828.

1933. *Gnarosophia palmensis austrina* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. New name for preceding. Figd. Fulton, Journ. Malac., Vol. xi., p. 8, pl. i., figs. 7-8, April 25, 1904.
North Queensland (Palm Islands).

GNAROSOPHIA MAZEE Brazier, 1878.

1878. *Helix mazee* Brazier, Proc. Linn. Soc. N.S.W., Vol. iii., p. 79, pl. 8, fig. 5, December. Cardwell, Queensland.

1889. *Helix calamus* Paetel, Cat. Conch. Samml. Paetel, Vol. ii., p. 112, *nom. nud.,* ex Brazier MS. "Austrl."
North Queensland (Cardwell district).

GNAROSOPHIA BELLARIA *sp. nov.*
(Plate ii., fig. 16.)

Recalling *palmensis*, but with the columella appressed closing the umbilicus, and the coloration bolder, the bands more separated.
North Queensland (Hinchinbrook Island).

GNAROSOPHIA RAWNESLEYI Cox, 1873.

1873. *Helix (Camaena) rawnesleyi* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 564, pl. xlviii., fig. 2, November. Mt. Elliott, Port Denison.
Mid Queensland (Port Denison district).

GNAROSOPHIA MOURILYANI Brazier, 1875.

1875. *Helix (Hadra) mourilyani* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 31, pl. iv., fig. 1, June 1. Bowen, Port Denison, Queensland.
Mid Queensland (Port Denison district).

Genus TEMPORENA Iredale, 1933.

1933. *Temporena* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. Orthotype, *Helix whartoni* Cox.

TEMPORENA WHARTONI Cox, 1871.

1871. *Helix whartoni* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 55, pl. iii., figs. 5-5a, June 12. "Port Denison, Queensland" error = Holbourne Island.
Mid Queensland (Holbourne Island only).

TEMPORENA MITIFICA Iredale, 1933.
(Plate ii., fig. 18.)

1933. *Gnarosophia mitifica* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. New name for
1864. *Helix incei* var. *multifasciata* Cox, Cat. Austr. Land Shells, p. 9. "Cape York-Murphy" error. Figd. Cox, Mon. Austr. Land Shells, pl. xviii., fig. 1, May, 1868. Not *Helix multifasciata* Weinland & Anton, Malak. Blatt., Vol. vi., p. 17, 1857.
Queensland.

Memo.—The exact locality whence this fine shell was found is not yet known. Murphy accompanied Leichhardt, and this shell may have been picked up anywhere on the way. It looks just like a very large relative of the island shell *whartoni*.

Genus SPHAEROSPIRA Mörch, 1867.

1867. *Sphaerospira* Mörch, Journ. de Conch., Vol. xv., p. 256, July 1. Logotype Pilsbry, Man. Conch. (Tryon), Ser. 2, Vol. vi. (pt. 24), p. 304, May 1, 1891, *Helix fraseri* "Gray".

SPHAEROSPIRA FRASERI Griffith & Pidgeon, 1833.

1833. *Helix fraseri* Griffith & Pidgeon, Anim. Kingdom (Cuvier), Vol. xii., pl. 36, fig. 6, fig. reversed; 1834, pl. 36*, fig. 6, figure corrected, Index, p. 597, ex Gray MS. New Holland.
1834. *Helix fraseri* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 64, November; coll. by Allan Cunningham = Hay's Peak = Toowoomba, South Queensland.

1829. *Helix coarctata* Férussac, Hist. Nat. Moll., livr., 31, pl. 10b, figs. 6-7. No locality. Not *Helix coarctata* Montagu, Test. Brit., Vol. ii., p. 445, 1803.
1835. *Helix capucinus* Férussac, Bull. Univ. Zool., Sect. ii., p. 74, as synonym in review.
1888. *Helix fraseri* var. *flavescens* Hedley, Proc. Roy. Soc. Queensld., Vol. v., p. 151. Colour var. only, Curumbin Creek, Queensland. Not *Helix flavescens* Pfeiffer, Mon. Helic. viv., Vol. i., p. 337, 1848.
Northern New South Wales. South Queensland.

Note.—This well known shell appears to show definite local variation as Clarence River specimens are smaller than the typical series and are less elevated, measuring 43 mm. in breadth by 34 mm. in height, and may be called *S. fraseri permuta* subsp. nov. Pl. ii., fig. 13. The ranges of these forms cannot be at present delimited, but the extremes appear very different. A very elevated small form from Stradbroke Island may be called *S. f. feriarum* subsp. nov., measuring 40 mm. by 40 mm. Pl. ii., fig. 14.

SPHAEROSPIRA MOSSMANI Brazier, 1875.

1875. *Helix (Hadra) mossmani* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 33, pl. iv., fig. 6, June 1. Dawson River, Queensland.
South Queensland (Dawson River).

Note.—This has been associated with *fraseri,* but the figure shows a very distinct form, so it must be left as valid until further knowledge of it is gained.

SPHAEROSPIRA PARALLELA *sp. nov.*
(Plate ii., fig. 10.)

A shell was collected at Palmwoods, South Queensland, by Mr. Arthur Livingstone, of this Museum, which resembles *S. informis* more than it recalls *fraseri.* It is as large as the former, measuring 45 mm. in height by 55 mm. in breadth, but has the upper whorls flattened, not rounded, and the umbilicus is slightly open. Two others from Nambour confirm this, being larger still, but with the umbilicus closed. A series from North Pine River show this Blackall Range living shell to be very distinct, and the type is selected from this locality, measuring 55 mm. in height by 55 mm. in breadth.

South Queensland (Blackall Ranges).

SPHAEROSPIRA INFORMIS Mousson, 1869.

1869. *Helix informis* Mousson, Journ. de Conch., Vol. xvii., p. 59, pl. iv., fig. 3, January 1. Port Mackay, Queensland.
1875. *Helix infurius* Ten.-Woods, Papers Proc. Roy. Soc. Tasm., 1874, p. 52. Error only.
Mid Queensland (Mackay to Bowen).

Note.—The type is a medium sized unicolor shell, but shells from Finch Hatton, 50 miles west of Mackay, are banded, more elevated, with a less open umbilicus, and these may be called *S. i. fringilla* subsp. nov.; pl. ii., fig. 12; this has been figured by Pilsbry (Man. Conch. (Tryon), Ser. ii., Vol. viii., p. 282, pl. 51, fig. 28, July 1, 1893); a series of shells from Mt. Dryander, Port Denison, are larger with more rounded whorls, and the umbilicus almost closed; these are named *S. i. dietrichae* subsp. nov., and this was figured by Pilsbry *loc. cit.*, fig. 27. It may be noted that this is the largest Australian Helicoid, except *Hedleyella,* exceeding *bipartita* in size, measuring 70 mm. in height by 68 mm. in breadth. Pl. ii., fig. 11.

Genus BENTOSITES Iredale, 1933.

1933. *Bentosites* Iredale, Rec. Austr. Mus., Vol. xix., p. 44, August 2. Orthotype, *Helix macleayi* Cox.

BENTOSITES MACLEAYI Cox, 1865.

1865. *Helix macleayi* Cox, Proc. Zool. Soc. (Lond.), 1864, p. 486, text figs., May 2, 1865. Port Denison, Queensland (suggested to be in error for Whitsunday Island, but still doubtful). Figd. Cox, Mon. Austr. Land Shells, p. 45, pl. viii., fig. 3, May, 1868.

1933. *Bentosites macleayi wardiana* Iredale, Rec. Austr. Mus., Vol. xix., p. 44, August 2. Hayman Island, Whitsunday Group, Queensland (M. Ward). Pl. ii., fig. 22.

Mid Queensland (Islands of Whitsunday Passage).

Note.—The subspecific names will be for convenience and saving of space, grouped under the species, as many more will later be named.

BENTOSITES ETHERIDGEI Brazier, 1877.

1877. *Helix (Calliocochlias) etheridgei* Brazier, Proc. Linn. Soc. N.S.W., Vol. ii., p. 25, July. "Andromache River, near Bowen", error = Hydrometer River, near Mackay, Queensland. Figd. Fulton, Journ. Malac., Vol. xi., p. 9, pl. i., fig. 2, April 25, 1904.

Mid Queensland.

BENTOSITES GAVISA Iredale, 1933.

1933. *Bentosites gavisa* Iredale, Rec. Austr. Mus., Vol. xix., p. 44, August 2. New name for

1871. *Helix gratiosa* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 53, pl. iii., fig. 1, June 12. Whitsunday Island, Queensland. Not *H. gratiosa* Studer, Nat. Anz. Allg. Schweiz. Gesell., Vol. iii., p. 87, 1820.

Mid Queensland (Whitsunday Island).

BENTOSITES BIRCHI Iredale, 1933.
(Plate ii., fig. 21.)

1933. *Bentosites birchi* Iredale, Rec. Austr. Mus., Vol. xix., p. 44, August 2. Proserpine River, Queensland.

Mid Queensland (Proserpine River district).

BENTOSITES COXI Crosse, 1866.

1866. *Helix coxi* Crosse, Journ. de Conch., Vol. xiv., p. 195, April 1. New name for

1864. *Helix cerea* Cox, Cat. Austr. Land Shells, p. 36. New name for

1864. *Helix forbesii* Cox, Proc. Zool. Soc. (Lond.), 1864, p. 490, text figs., June 24. Port Denison, Queensland (Masters). Not *H. forbesii* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 71. Nor *H. cerea* Gould, Proc. Bost. Soc. Nat. Hist., Vol. iii., p. 194, 1850.

1868. *Helix cerata* Cox, Mon. Austr. Land Shells, p. 58, pl. viii., fig. 4, May. New name for *H. cerea* Cox.

Mid Queensland (Port Denison district).

BENTOSITES CROFTONI Cox, 1872.

1872. *Helix (Helicostyla) croftoni* Cox, Proc. Zool. Soc. (Lond.), 1872, p. 18, pl. iv., fig. 1, June 1. Hydrometer River, Mackay, Queensland.

Mid Queensland (Mackay district).

BENTOSITES BLOMFIELDI Cox, 1864.

1864. *Helix blomfieldi* Cox, Cat. Austr. Land Shells, p. 19, Miriam Vale, Port Curtis, Queensland (Blomfield). Figd. Cox, Mon. Austr. Land Shells, p. 57, pl. i., fig. 1, May, 1868.
1892. *Hadra blomfieldi* var. *warroensis* Hedley & Musson, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vi., p. 556, May 23. Warro, near Port Curtis, Queensland.
1933. *Bentosites blomfieldi sidneyi* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Coolabunia, Kingaroy, South Queensland. Pl. ii., fig. 23.
1933. *Bentosites blomfieldi latior* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Mary River, Queensland. Pl. ii., fig. 24.
South Queensland (Port Curtis district to the southward).

Genus VAROHADRA Iredale, 1933.

1933. *Varohadra* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Orthotype, *Helix oconnellensis* Cox.
1933. *Figuladra* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Orthotype, *Helix curtisiana* Pfeiffer.

VAROHADRA OCONNELLENSIS Cox, 1871.

1871. *Helix oconnellensis* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 55, pl. iii., fig. 4, June 12. O'Connell River, near Port Denison, Queensland.
1869. *Helix albofilata* Schmeltz, Mus. Godeff., Cat. iv., p. 73 (pref. May 18). ex Mousson MS., *nomen nudum*. Mackay, Queensland.
1874. *Helix oconnelli* Schmeltz, Mus. Godeff., Cat. v., p. 94, February. Error pro *oconnellensis* Cox = *albofilata* as above.
1874. *Helix albomarginata* Schmeltz, Mus. Godeff., Cat. v., p. 94, February. ex Mousson MS., *nomen nudum*. Bowen, Queensland.
1933. *Varohadra oconnellensis jacksoni* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Finch Hatton, 50 miles west of Mackay, Queensland. Pl. ii., fig. 20.
1933. *Varohadra oconnellensis caroli* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Lindeman Island, Whitsunday Group, Queensland. Pl. ii., fig. 19.
Mid Queensland (Port Denison district and islands of Whitsunday Passage).

VAROHADRA ARTHURIANA Cox, 1873.

1873. *Helix arthuriana* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 564, pl. xlviii., fig. 1a, November. "L. Island, Torres Strait". Error = L. Island, Broad Sound, Queensland.
Mid Queensland (L. Island).

VAROHADRA YULEI Forbes, 1851.

1851. *Helix yulei* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 377, pl. ii., figs. 6 a-b, "1852" = Mid December, 1851. Port Molle, Queensland.
Mid Queensland (Port Molle).

VAROHADRA RAINBIRDI Cox, 1870.

1870. *Helix rainbirdi* Cox, Proc. Zool. Soc. (Lond.), 1870, p. 170, pl. xvi., fig. 1, November. Mt. Dryander, Port Denison, Queensland.
Mid Queensland (Mt. Dryander).

Varohadra starena *sp. nov.*
(Plate iii., fig. 1.)

From Whitsunday Island shells, similarly coloured to *rainbirdi,* are less elevated, with the umbilicus less open and the base less excavated. Apparently they are also smaller, the type measuring 37 mm. in breadth, and 25 mm. in height.

Varohadra findera *sp. nov.*
(Plate iii., fig. 2.)

1890. *Helix basalis* Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. vi., p. 158, pl. 39, figs. 84-85, December 16. ex Mousson MS. Port Mackay, Queensland. Not *H. basalis* Schmeltz, Mus. Godeffr. Cat. iv., p. 135, 1869.

This species is smaller than *rainbirdi,* though alike in coloration, more elevated, the base excavated, the umbilicus fairly open, and measures 34 mm. in breadth by 28 mm. in height.

Varohadra thorogoodi *sp. nov.*
(Plate iii., fig. 3.)

1890. *Helix rainbirdi* var. Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. vi., p. 158, pl. 35, figs. 6-7, December 16. Locality unknown exactly = Proserpine and O'Connell River.

This distinct species with its flattened whorls, the sutures scarcely impressed, has the umbilicus well excavated, but has only one anteperipheral orange band. It measures 38 mm. in breadth by 24 mm. in height.

Varohadra macneilli *sp. nov.*
(Plate iii., fig. 4.)

A very small flattened member of the *rainbirdi* series was collected by Mr. F. A. McNeill, of this Museum, at Double Cone, an island midway between Bowen and Holbourne Island. It has a narrower umbilicus almost hidden, the base rounded, and a dark periostracum, measuring 30 mm. in breadth by 20 mm. in height.

Varohadra rockhamptonensis Cox, 1873.

1873. *Helix rockhamptonensis* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 151, June. Rockhampton, Queensland.
1876. *Helix moresbyi* Angas, Proc. Zool. Soc. (Lond.), 1876, p. 267, pl. xx., figs. 8-9, June 1. Port Denison, Queensland, error = Rockhampton, Queensland.
1881. *Helix planibasis* Brazier, Proc. Linn. Soc. N.S.W,. Vol. v., p. 445, February, ex Cox MS., as a synonym.
1892. *Hadra rockhamptonensis* var. *pallida* Hedley & Musson, Proc. Linn. Soc. N.S.W., Ser. ii., Vol. vi., p. 556, May 23. Rockhampton, Queensland.

South Queensland (Rockhampton district).

Shells from Mt. Etna Caves district are less elevated, with the umbilicus more covered, the mouth more expanded (and are probably *planibasis* of Cox), measuring 30 mm. in height by 36 mm. in breadth. This may be called *V. r. decreta* subsp. nov. Pl. iii., fig. 5.

Varohadra yeppoonensis Beddome, 1897.

1897. *Helix (Hadra) yeppoonensis* Beddome, Proc. Linn. Soc. N.S.W., Vol

xxii., p. 123, fig. in text (not of type), September 17. Yeppoon, near Rockhampton, Queensland.
South Queensland (Yeppoon).

VAROHADRA LESSONI Pfeiffer, 1846.

1846. *Helix lessoni* Pfeiffer, Symb. hist. Helic., Vol. iii., p. 71, Australia (probably collected on Voyage Fly): restricted type locality = Percy Isles, S. Queensland. Figd. Syst. Conch. Cab. (Mart. & Chemnitz), cont., Kuster, Bd. i., Abth. xii., Theil. 3, p. 363, pl. 138, figs. 9-10, 1854.
South Queensland (Percy Isles).

VAROHADRA AUREEDENSIS Brazier, 1872.

1872. *Helix (Camaena) aureedensis* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 640, May 2, 1872. "Aureed Is., Torres Strait". Error = Port Denison district. Figd. Pilsbry, Man. Conch. (Tryon), Ser. ii., Vol. viii., p. 282, pl. 54, figs. 7, 8, 9, July 1, 1893.
Mid Queensland (on islands off Port Denison).

VAROHADRA BALA Brazier, 1878.

1878. *Helix bala* Brazier, Proc. Linn. Soc. N.S.W., Vol. iii., p. 78, pl. 8, fig. 4, December. Castle Hill, near Townsville; also Magnetic Island.
North Queensland (Magnetic Island).

The type is marked Magnetic Island, and shells conspecific have been seen from that locality.

VAROHADRA BERNHARDI Iredale, 1933.
(Plate iii., fig. 7.)

1933. *Varohadra bernhardi* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Rockhampton, Queensland (H. Bernhard).
South Queensland (Rockhampton district).

VAROHADRA CURTISIANA Pfeiffer, 1864.

1864. *Helix curtisiana* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 528, April 20, 1864. Port Curtis, Queensland (= Mt. Larcom). Figd. Cox, Mon. Austr. Land Shells, p. 58, pl. xx., fig. 9, May, 1868 (from a painting of the type by Angas).
1864. *Helix seminigra* Morelet, Journ. de Conch., Vol. xii., p. 289, July 1. Queensland = Port Curtis.
1869. *Helix basalis* Schmeltz, Mus. Godeffr. Cat., iv., p. 135, ex p. 73, *nom. nud.* (pref. May 18), ex Mousson MS. as a synonym of *curtisiana*.
1872. *Helix (Hadra) parsoni* Cox, Proc. Zool. Soc. (Lond.), 1872, p. 18, pl. iv., fig. 2, June 1. "Gayndah, Queensland" error; specimens agreeing with description are labelled Miriam Vale; others similar have been collected at Olsen's Caves, none at Gayndah.
1933. *Varohadra curtisiana exedra* Iredale, Rec. Austr. Mus., Vol. xix., p. 45, August 2. Boyne Island, Port Curtis, Queensland. pl. iii., fig. 6.
South Queensland (Port Curtis district).

VAROHADRA CONCORS Fulton, 1904.

1904. *Thersites concors* Fulton, Journ. Malac., Vol. xi., p. 8, pl. i., fig. 3, April 25. Gayndah, Queensland.
South Queensland (Gayndah district).

VAROHADRA INCEI Philippi, 1846.

1846. *Helix incei* Philippi, Abbild. Beschr. Conch., Vol. ii., p. 83, pl. vii., fig. 3, February, ex Pfeiffer MS. Australia (ex Ince) = Percy Islands, South Queensland.

1846. *Helix incei* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 126, February, 1846. North Australia (Ince). Figd. Pfeiffer, Syst. Conch. Cab. (Martini & Chemnitz), cont. Kuster, Bd. i., Abth xii., Theil. i., p. 327, pl. 58, figs. 1-3, 1849?

1869. *Helix incei* var. *depressior* Schmeltz, Mus. Godeffr. Cat. iii., p. 73 (pref. May 18), *nomen nudum*.
South Queensland (Percy Isles).

Note.—Though this specific name has been used for shells from Port Curtis, it had been collected by Ince, who did not visit that locality. I noted that Port Denison was a better locality, but Forbes, from the personal knowledge of Macgillivray, recorded "Percy Isles, Keppel Is., Port Molle". The figure shows an elevated shell, and specimens from the Keppel Isles and Port Molle are both depressed, so "Percy Isles" is here designated as type locality of *incei*.

VAROHADRA CHALLISI Cox, 1873.

1873. *Helix* (*Camaena*) *challisi* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 565, pl. xlviii., fig. 3, November. "L. Island, Torres Strait"; error = L. Island, Broad Sound, Mid Queensland.
Mid Queensland (L. Island).

VAROHADRA KEPPELENSIS *sp. nov.*

(Plate iii., fig. 8.)

A series of shells collected by Mr. H. Bernhard on the Keppel Isles generally agree with topotypes of *challisi*, but especially lack the subsutural brown band. They differ from the type of *incei* in their more depressed form. North Keppel Island shells are large and solid, but from Rocky Point, S.W. point of the island, the specimens are smaller, very thin, even fragile and scantily banded. The South Keppel Island shells are still smaller, thin, more elevated, some with the lines numerous, but generally with few lines, the umbilicus narrow almost hidden by expansion of the columella; the lip white; these may be called *V. k. degener* subsp. nov. Pl. iii., fig. 9.

VAROHADRA MATTEA Iredale, 1933.

(Plate iii., fig. 11.)

1933. *Varohadra incei mattea* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. Rockhampton, Queensland (H. Bernhard).
South Queensland.

VAROHADRA MORTENSENI Iredale, 1929.

1929. *Hadra mortenseni* Iredale, Mem. Queensland Mus., Vol. ix., p. 292, pl. xxxi., fig. 9, June 29. Queensland = Parnassus Range, north of Byfield (R. H. Mortensen).
South Queensland (Parnassus Range).

VAROHADRA VOLGIOLA Iredale, 1933.

1933. *Varohadra volgiola* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. New name for

1872. *Helix andersoni* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 644, pl. 52, fig. 4, May 2, 1872. North end Expedition Range, near Rockhampton, Queensland. Not *H. andersoni* Blandford, Proc. Zool. Soc. (Lond.), 1869, p. 448.
South Queensland (Expedition Range).

VAROHADRA FORTASSE Iredale, 1933.
(Plate iii., fig. 10.)

1933. *Varohadra volgiola fortasse* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. Lindeman Is., Whitsunday Group, Queensland.
Mid Queensland (Lindeman Island).

VAROHADRA SAXICOLA *sp. nov.*
(Plate iii., fig. 12.)

A series of shells from Stone Island in Port Denison are small, depressed, recalling *mattea,* but with a red circum-umbilical patch, the umbilicus closed by the appression of the red columella, the outer lip reddish. There is a subsutural red band. This species has been recorded as *incei,* and also as *andersoni* = *volgiola,* but it appears quite distinct from either. Mainland shells from near Bowen are a little more elevated, but otherwise very similar and with the umbilicus sometimes showing a chink.

Mid Queensland (Port Denison district).

VAROHADRA BAYENSIS Brazier, 1875.
(Plate iii., fig. 14.)

1875. *Helix (Hadra) bayensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 2, April 27. Wide Bay, Queensland.
South Queensland (Wide Bay district).

Note.—The exact locality of this fine shell is not known, but there are similar shells, but smaller from Tenningering (Mt. Perry), inland from Bundaberg, while Musson recorded *bayensis* from Banbam, near Maryborough. The smaller shell measuring 39 mm. in breadth by 28 mm. in height, outer lip purplish white, expanded columella almost concealing the umbilicus, may be called *Varohadra bayensis reducta* subsp. nov. Pl. iii., fig. 15.

VAROHADRA APPENDICULATA Reeve, 1854.

1854. *Helix appendiculata* Reeve, Conch. Icon., Vol. vii., pl. 193, sp. 1353, August, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 149, April 11, 1855). Australia = Bersaker Range, near Rockhampton, Queensland.

1870. *Helix thatcheri* Cox, Proc. Zool. Soc. (Lond.), 1870, p. 170, pl. xvi., fig. 2, November. Mt. Bersaker, Rockhampton, South Queensland.
South Queensland (Bersaker Ranges).

Note.—These two are subspecies, the mouth in the latter being white, the typical form having the outer lip dark; the form is characteristic as described, but apparently the shell varies in height, although the depressed shell is the normal one.

VAROHADRA ZEBINA Brazier, 1878.

1878. *Helix zebina* Brazier, Proc. Linn. Soc. N.S.W., Vol. ii., p. 78, pl. 8, fig. 2, December. Douglas River, Queensland.
North Queensland (inland from Townsville).

VAROHADRA PROBLEEMA Iredale, 1933.
(Plate iii., fig. 16.)

1933. *Varohadra probleema* Iredale, Rec. Austr. Mus., Vol. xix., p. 46, August 2. Hamilton Island, Whitsunday Group, Queensland (M. Ward).
Mid Queensland (Hamilton Island).

VAROHADRA HANNI Brazier, 1876.

1876. *Helix* (*Hydra*) *hanni* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 97, July. Bowen, Port Denison, Queensland (Coll. C. Coxen).
Mid Queensland.

VAROHADRA JOHNSTONEI Brazier, 1875.

1875. *Helix* (*Hadra*) *johnstonei* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 32, pl. iv., fig. 2, June 1. Bowen, Queensland.
Mid Queensland.

VAROHADRA HILLI Brazier, 1875.

1875. *Helix* (*Hadra*) *hilli* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 32, pl. iv., fig. 3, June 1. Mt. Elliott, Townsville, Queensland.
North Queensland (Townsville).

VAROHADRA TOMSONI Brazier, 1876.
(Plate iii., fig. 13.)

1876. *Helix* (*Hydra*) *tomsoni* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 97, July. Mt. Elliott, Townsville, Queensland.
North Queensland (Townsville).

VAROHADRA COOKENSIS Brazier, 1875.
(Plate iii., fig. 18.)

1875. *Helix* (*Hadra*) *cookensis* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 17, April 27, 1875. "Cooktown, North Queensland", error = Brooke Island, Rockingham Bay, *fide* Brazier.
North Queensland (Brooke Island).

VAROHADRA PRAETERMISSI Cox, 1868.

1868. *Helix* (*Camaena*) *praetermissi* Cox, Mon. Austr. Land Shells, add. page 111, pl. xx., fig. 13 (after May). Cape Direction, North Queensland.
North Queensland (Cape Direction).

Note.—This locality is very doubtful.

VAROHADRA BEBIAS Brazier, 1878.

1878. *Helix bebias* Brazier, Proc. Linn. Soc. N.S.W., Vol. iii., p. 78, pl. 8, fig. 1, December. Garden Island, Rockingham Bay, Queensland.
North Queensland (Garden Island).

Note.—The preceding seven species are not too well known; the locality of *hanni* may be incorrect, the type was in a private collection, and has not been figured; the locality given for *johnstonei* is also in doubt, and the figure suggests that it may be related to *rawnesleyi* or *mazee*; although Mt. Elliott is given as locality of *hilli*, many specimens from Bundaberg have been so determined, while many specimens from Frazer Island have been named as *johnstonei* also, by Brazier himself; the type of *tomsoni* was also

in a private collection and unfigured, but specimens from Townsville recently collected appear to agree; *cookensis* was described from Cooktown, but Brazier himself corrected this to Brooke Island, Rockingham Bay; unfortunately specimens from the latter locality so named do not agree with the original description of *cookensis*; *praetermissi* is in like predicament, as it almost certainly did not come from Cape Direction, but from some island south of Rockingham Bay, as far as can be judged from the type specimen preserved in the Australian Museum. Without series there can be no certainty in connection with any of these species.

VAROHADRA RUSSELLI *sp. nov.*
(Plate iii., fig. 19.)

Specimens collected by Mr. F. S. Russell, of the British Great Barrier Reef Expedition, at North Barnard Island, resemble *bebias* Brazier, but are larger, the umbilicus almost closed, the mouth white with a pinkish tinge; no subsutural band, nor red umbilical patch, very fine wrinkle sculpture rarely being present; measurements, 36 mm. in breadth by 27 mm. in height.

North Queensland (North Barnard Island).

VAROHADRA HUBBARDI *sp. nov.*
(Plate iii., fig. 20.)

Some years ago the Rev. Percy Hubbard, then at Innisfail, forwarded some land snails collected on the Johnstone River thereby, and they represent quite a novelty from that district, being small, similar to *tomsoni*, the sculpture showing the faint wrinkling of northern shells, the umbilicus hidden but not closed. The measurements: breadth 34 mm., height 28 mm.

North Queensland (Johnstone River district).

VAROHADRA HALLEYAE *sp. nov.*
(Plate iii., fig. 21.)

A very curious form was collected at Lindeman Island by Mrs. Melbourne Ward, being bright unicolor, brown-red, elevated, umbilicus closed, surface matt, no visible wrinkle sculpture. Height, 28 mm.; breadth 35 mm.

Mid Queensland (Lindeman Island).

VAROHADRA BANFIELDI *sp. nov.*
(Plate iii., fig. 17.)

This species was recorded by Banfield as *fraseri*, and then determined by Hedley as *cookensis* and then again as *appendiculata*. It is nearest the traditional *cookensis*, but is larger, more solid, the umbilicus as a small chink, and the sculpture of the wrinkling style only showing on the earlier whorls. Measurements: breadth 39 mm.; height 32 mm.

North Queensland (Dunk Island).

Genus PALLIDELIX Iredale, 1933.

1933. *Pallidelix* Iredale, Rec. Austr. Mus., Vol. xix., p. 47, August 2. Orthotype, *Helix greenhilli* Cox.

PALLIDELIX GREENHILLI Cox, 1866.

1866. *Helix greenhilli* Cox, Journ. de Conch., Vol. xiv., p. 46, January 1; Proc. Zool. Soc. (Lond.), 1865, p. 696, April 24, 1866. Upper Dawson River, Queensland (Greenhill). Figd. Cox, Mon. Austr. Land Shells, p. 40, pl. ix., fig. 1; pl. xviii., fig. 8, May, 1868.
Mid Queensland.

PALLIDELIX SARDALABIATA Cox, 1871.

1871. *Helix sardalabiata* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 54, pl. iii., figs. 3-3a, June 12. Mt. Dryander, Port Denison, North Queensland.
1872. *Helix* (*Hadra*) *stephensoniana* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 639, May 2, 1872. Port Denison, Queensland. Pl. iii., fig. 23.
Mid Queensland.

Shells from Brooke Island are more elevated with the umbilicus closed, but with the same sculpture as *stephensoniana*; they had been named *spurlingi* by Brazier MS. and this name is used, the type of *P. spurlingi* sp. nov. being: height 30 mm.; breadth 35 mm. Pl. iii., fig. 24.

Genus MICARDISTA Iredale, 1933.

1933. *Micardista* Iredale, Rec. Austr. Mus., Vol. xix., p. 47, August 2. Orthotype, *Helix barneyi* Cox.

MICARDISTA BARNEYI Cox, 1873.

1873. *Helix* (*Camaena*) *barneyi* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 148, pl. xvi., fig. 2, June. "Barney Island, Torres Strait". Error = Cape Sidmouth, Queensland.
North Queensland.

Genus ANNAKELEA Iredale, 1933.

1933. *Annakelea* Iredale, Rec. Austr. Mus., Vol. xix., p. 43, August 2. Orthotype, *Helix richmondiana* Reeve.
1894. *Thersites* Pilsbry, Man. Conch., Ser. ii., Vol. ix., p. 125. (Not *Thersites* Pfeiffer, Zeitschr. für Malak., 1855, p. 141. Tautotype, *Helix thersites* Broderip.).

ANNAKELEA RICHMONDIANA Reeve, 1852.

1852. *Helix richmondiana* Reeve, Conch. Icon., Vol. vii., pl. lxx., sp. 365, January, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1851, p. 252, July 26, 1853). Richmond River, New South Wales.
1890. *Helix richmondiana* forma *decolorata* Pilsbry, Man. Conch., Ser. ii., Vol. vi., p. 9, August 12. No locality = Richmond River, New South Wales.
Northern New South Wales. South Queensland.

ANNAKELEA MITCHELLAE Cox, 1864.

1864. *Helix mitchellae* Cox, Cat. Austr. Land Shells, p. 19. Clarence River, New South Wales (Mitchell). Figd. Cox, Mon. Austr. Land Shells, p. 65, pl. ix., fig. 9, May, 1868.
Northern New South Wales.

ANNAKELEA PERAGRANS *sp. nov.*

(Plate iii., fig. 22.)

Apparently this species has been masquerading as *mitchellae,* as Cox figured a similar shell in 1868. In 1864 he had described under the name *mitchellae* a shell measuring 1.056 in. in diameter and 1.015 inches in height. He described it as "elevated" and "angulate", but the later species is much more elevated and is *not* angulate, but has the periphery rounded, and both were localised as from the Clarence River. All the larger shells are from the Richmond River and northwards. From Bangalow, Byron Bay, the largest ones measure nearly two inches high and two inches broad, and these are named as above until topotypical "Clarence River" specimens can

be examined. The type measures 48 mm. in height and 48 mm. in breadth, but some broader shells reach 54 mm. in breadth.

ANNAKELEA TYMPANUM *sp. nov.*
(Plate iii., fig. 25.)

A shell brought back from Mt. Tambourine, South Queensland, by Mr. A. Musgrave, of this Museum, is a remarkable find. Upon examination, it is found to be a giant relative of *novaehollandiae* = *dupuyana,* whose range lies much to the southward, with the different *mitchellae* and *richmondiana* intervening.

The largest Bellenger River specimen reaches 41 mm. in diameter, while the Tambourine shell measures 47 mm. across with a height of 34 mm.

ANNAKELEA NOVAEHOLLANDIAE Gray, 1834.

1834. *Carocolla novaehollandiae* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 67, November 25. "200 millia passuum ab Ostio Fluvii Macquarie", error = Scone, New South Wales.

1850. *Helix depugana* Jay, Catal., 4th ed., p. 135, n. 3610, *nomen nudum,* ex Pfeiffer MS. (error of spelling only).

1851. *Helix dupuyana* Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. ii., pl. 124, figs. 15-16 (p. 280, 1852, cites "Reeve, Conch. Icon.", and "Pfeiffer, Proc. Zool. Soc. (Lond.), 1851", but the name never appeared in the latter place). East coast of New Holland = Bellingen River, N.S.W.

1851. *Helix dupuyana* Forbes, Narr. Voy. Rattlesnake (Macgillivray), Vol. ii., p. 371, "1852" = Mid-December, 1851, cites Pfeiffer's plate and gives Bellingen River, N.S.W. (Macgillivray).

1852. *Helix dupuyana* Reeve, Conch. Icon., Vol. vii., pl. lxviii., sp. 354, January, ex Pfeiffer.

Northern New South Wales (Hunter River to Bellingen River).

EXPLANATION OF PLATE I.

Fig. 1. *Pedinogyra hayii* Griffith and Pidgeon, under surface.
,, 2. *Pedinogyra hayii* Griffith and Pidgeon, side view.
,, 3. *Pedinogyra effossa* Iredale, under surface.
,, 4. *Pedinogyra effosa* Iredale, side view.
,, 5. *Pedinogyra rotabilis elsa* Iredale, under surface.
,, 6. *Pedinogyra rotabilis elsa* Iredale, side view.
,, 7. *Pedinogyra allani* Iredale, side view.
,, 8. *Pedinogyra allani* Iredale, under surface.
,, 9. *Pedinogyra nanna* Iredale, under surface.
,, 10. *Pedinogyra nanna* Iredale, side view.
,, 11. *Mussonula verax* Iredale.
,, 12. *Turrisitala wildiana* Iredale.
,, 13. *Hedleyoconcha duona* Iredale.

EXPLANATION OF PLATE II.

Fig. 1. *Hadra webbi incallida* Iredale.
,, 2. *Hadra blighi* Iredale.
,, 3. *Hadra (bartschi) quaesita* Iredale.

Fig. 4. *Spurlingia helga* Iredale.
„ 5. *Spurlingia portus* Iredale.
„ 6. *Spurlingia cadmus* Iredale.
„ 7. *Spurlingia gemma* Iredale.
„ 8. *Zyghelix darwini* Brazier.
„ 9. *Spurlingia excellens* Iredale.
„ 10. *Sphaerospira parallela* Iredale.
„ 11. *Sphaerospira informis dietrichae* Iredale.
„ 12. *Sphaerospira informis fringilla* Iredale.
„ 13. *Sphaerospira fraseri permuta* Iredale.
„ 14. *Sphaerospira fraseri feriarum* Iredale.
„ 15. *Gnarosophia mulgravensis* Brazier.
„ 16. *Gnarosophia bellaria* Iredale.
„ 17. *Gnarosophia humoricola* Iredale.
„ 18. *Temporena mitifica* Iredale.
„ 19. *Varohadra oconnellensis caroli* Iredale.
„ 20. *Varohadra oconnellensis jacksoni* Iredale.
„ 21. *Bentosites birchi* Iredale.
„ 22. *Bentosites macleayi wardiana* Iredale.
„ 23. *Bentosites blomfieldi sidneyi* Iredale.
„ 24. *Bentosites blomfieldi latior* Iredale.

EXPLANATION OF PLATE III.

Fig. 1. *Varohadra starena* Iredale.
„ 2. *Varohadra findera* Iredale.
„ 3. *Varohadra thorogoodi* Iredale.
„ 4. *Varohadra macneilli* Iredale.
„ 5. *Varohadra rockhamptonensis decreta* Iredale.
„ 6. *Varohadra curtisiana exedra* Iredale.
„ 7. *Varohadra bernhardi* Iredale.
„ 8. *Varohadra keppelensis* Iredale.
„ 9. *Varohadra keppelensis degener* Iredale.
„ 10. *Varohadra fortasse* Iredale.
„ 11. *Varohadra mattea* Iredale.
„ 12. *Varohadra saxicola* Iredale.
„ 13. *Varohadra tomsoni* Brazier.
„ 14. *Varohadra bayensis* Brazier.
„ 15. *Varohadra bayensis reducta* Iredale.
„ 16. *Varohadra probleema* Iredale.
„ 17. *Varohadra banfieldi* Iredale.
„ 18. *Varohadra cookensis* Brazier.
„ 19. *Varohadra russelli* Iredale.
„ 20. *Varohadra hubbardi* Iredale.
„ 21. *Varohadra halleyae* Iredale.
„ 22. *Annakelea peragrans* Iredale.
„ 23. *Pallidelix stephensoniana* Brazier.
„ 24. *Pallidelix spurlingi* Iredale.
„ 25. *Annakelea tympanum* Iredale.

(To be continued.)

THE LAST LETTERS OF JOHN MacGILLIVRAY.

By Tom Iredale.

The name of MacGillivray will ever hold a foremost place in the Annals of British Ornithology, as William MacGillivray (1796-1852) fought a way from obscurity, through almost unbelievable hardships, to attain the post of Professor at Aberdeen, Scotland. The vicissitudes he suffered have been told by a sympathetic recorder, but those of the son are not so well known.

It may be interposed that the name of MacGillivray is not unfamiliar in Australian Annals, as a son of William, and younger brother of the subject of this article, was the well known Paul Howard, of Bendigo, Victoria, an authority on polyzoa.

The son John started very early on a brilliant career which apparently ended on a low rung. This conclusion does not seem just, now seventy years have lapsed, and the reading of this article will, I hope, lift the veil, and allow his life's work to be better appreciated, any lapse being overlooked through his services to Australian zoology.

Mr. John Brazier, the old-time Conchologist, told me about MacGillivray, contradicting some of the traditional tale, but I had no proof to substantiate Brazier's account. This year, a chance remark, brought to light the evidence that seems conclusive and of great importance.

Mr. J. S. P. Ramsay, the son of Dr. E. P. Ramsay, at one time Curator of the Australian Museum and the foremost Australian zoologist of his time, has loaned me a series of letters written by MacGillivray to his father when the latter was an enthusiastic youth. These letters are, without doubt, some of the most interesting letters dealing with natural history that have yet been published. Mr. Ramsay has generously allowed me to copy these and reproduce them here. Moreover, he has loaned me the famous three-barrelled gun MacGillivray used on his collecting trips and a photograph is here added, as well as the only picture drawn of MacGillivray.

To begin at the beginning, John was born at Aberdeen, Scotland, on December 18, 1821 (the date usually given being 1822). Apparently he was precocious as he was selected as Assistant Naturalist on the "Fly", a surveying vessel that visited Australia in the years 1842-1846. He then was appointed Naturalist on the "Rattlesnake" which surveyed the Australian coasts between 1846-1850. Again he secured the position of Naturalist on the surveying vessel "Herald" and left England in 1852. From this point until his sudden death in Sydney on June 6, 1867, little of reliable import was known about him, but lots of rumours of the downward trail.

I will let this series of letters speak for themselves and then add some comments. When the "Herald" reached Sydney, MacGillivray left the service (it is said in disgrace) and became a professional collector of botanical and zoological objects, travelling through the islands, but no details were known.

These letters are the last he ever wrote, but through their acquisition, Mr. W. A. Rainbow, Librarian at the Australian Museum, brought to me a small pocket book which had belonged to MacGillivray. This is illuminating as it proves to be his working notebook, full of notes of the objects he hoped to collect, the cost of collecting, the results of his expeditions, and more important a sketch of his travels, and notes of the articles he had written. From this we can fill in the years, and realise his energy and

knowledgeableness on every zoological subject, while he was most of the time depending on botany for his living.

It must be remembered when reading these letters that they were written in the field without reference to anything save his own memory; written by an active hunter at the end of a day's work, and I think readers will agree with me that the bulk of the rumours about his incapacity were, to say the least of them, much exaggerated, if not entirely unfounded.

The first letter is addressed to E. P. Ramsay, Esq., University, Sydney, from Grafton, July 4th, 1865, with a note added, July 9th, 1865, and begins: "I received yours of the 29th ult. last night on my return after a fortnight's absence and answer it now, as I have some leisure, the last I shall have for a week, in all probability, as we have 21 skins of kangaroos to fill —of various sizes, from an old man upwards of 6 feet high down to the little rock wallaby, and including 7 full grown wallaroos, great bulky creatures. I may have made a mistake respecting the naming of a sternum marked Geopelia tranquilla—in the first batch—as in the last lot there was a second one, the two ought to agree. At any rate, the second one cannot have been confounded with a Hiaticula, as I had not been shooting any of the latter birds about that time. The sterna of pigeons and some grallators are remarkably similar. At any rate, carefully compare the 2 sterna alluded to, and if the first does not agree with the second and resembles Hiaticula, it must be H. nigrifrons, the only Hiaticula or small sandpiper except Erythrogonys I have shot in this district. I have never seen *Lathamus discolor* in this colony, where it must be rare. I met with it abundantly in Tasmania. Regarding Nettapus—The 'faint mark around the chest' indicates a male not in full plumage. The under tail coverts are black in the male when in full plumage, but in the female always remain light. The mottled and banded markings on neck, breast, etc., sufficiently indicate the female at all times, besides the want of the metallic green, etc. Respecting *Ptilonopus,* Swainsoni & Ewingi, although closely allied, are very distinct. The former I never shot. I have seen a large number of specimens in one collection from the Manning, in which there was not one of Ewingi—a bird I have shot at Port Essington, Cape York, and elsewhere on the N.E. coast down to this place. Wilcox, however, *thinks* he has seen Swainsoni here also. I have not. *Ptilonopus Ewingi* is *smaller* than Swainsoni, has the crown rose pink and *not* deep crimson, breast pale greenish grey and *not* dull green, centre of abdomen rich orange and *not* lilac, tail feathers tipped with greenish yellow and *not* clear rich yellow, etc. I don't know what your specimen with purplish violet on back of head can be unless I saw it. Lesson described a New Guinea bird, Pt. cyanovirens, to which G. R. Gray referred well coloured in the head specimens in the B.M. shot by me on Wallis Islands, Torres Strait, referring other specimens of mine from same locality to *superbus.* Now I *know* they are the sexes of the same species, and Gray has since come to the same conclusion. Superbus I have also got at Cape York, but not, I think, elsewhere on the mainland. The young of Ewingi—sometimes at least—wants the pink on the head—at least, I have such here, which I wouldn't skin. You wish to know of our trip inland. We took a light dray which Wilcox drove, while I rode another horse. We had also a kangaroo dog—and when after a week Wilcox rode in to Grafton—for supplies—he brought back a pack horse in addition. We camped in a gorge of one of the valleys in the mountains through which runs one of the tributaries of the Urara, itself a branch of the Clarence. Several days elapsed before we were joined by the party of blacks without

whose assistance we should not have succeeded. We might, of course, have got shooting enough and some kangaroos, but our object was to make a collection of fine skins and skulls of as many sorts as could be procured at one time, and we persevered until we did so. I went out with the hunting party the first day we all mustered. I had, previously before going after the larger animals, gone out alone and shot rock wallabies, besides a lot of honeysuckers (Ptilotis Auricomis, Mel. sericea, etc., not found about Grafton) around the camp. Well, the first day we had 6 blacks, one of whom was furnished with a gun, and Wilcox and I had each his own, of course. In the long grass on a flat a mile up the valley we put up some kangaroos, to which the dog and blacks gave chase, making a tremendous noise, and so puzzled an old female that she did not notice me until I had given her a No. 2 cartridge, when she made a bolt, and after running 20 or 30 yards gave up the ghost. Planting the body, we ascended a steep mountain towards a gap leading into another valley in hopes of seeing some grey faces (*Osphranter Parryi*). Wilcox and a black with a gun skirted the range high up, while I did the same lower down, the whole of us forming an irregular line extending a mile. None of the shooters, however, but myself saw any. I observed 2 standing reconnoitring on the other side of a gully with no cover for me, so did not expect to get near. However, I tried and crawled a long way, the animals intently listening and looking another way at one of our blacks higher up. When I had got up to about 100 yards one suddenly bolted, and as there was not an instant to be lost I fired at the other still standing up, a little one beside her. She rolled over towards me into the gully, and when I came up she was dead—my first grey face—the most beautiful of all the kangaroos. Again in an acacia scrub I saw through the trees the head and ears of one partly covered by a tree, and on the instant of firing the creature bolted and I missed, but the shot rounded up about a dozen more, not one of which gave me a chance with the second barrel. They all went up the hill like a flock of sheep. Some time afterwards while following a sharp stony ridge where I started and shot a fine grey wallaby (*Halmaturus ruficollis*) I heard great shouting in a gorge below, and had not to look out long when another very fine grey face came in view, about 10 yards off, making right for me. Of course, he speedily diverged when a charge of (loose) shot made him roll over and over and stop. I was reloading, thinking it all right, when he got up again, hobbling along, and, as I thought I might lose him among the rocks and brushes, I was reluctantly obliged to give him a cartridge as soon as he had got far enough off. Then Wilcox joined me, and soon afterwards we put up a wallaroo, which he wounded, and half an hour afterwards saw again and shot. For the second time we stopped to skin the game when, of course, the blacks ate as much as they could stow away. We saw several more animals that day, one of which, a grey wallaby, was shot by a darkey. This was our first day's hunting. So I stayed in camp skinning while the others kept me going. As I don't care much about shooting *now*, it was a capital thing for my companion, who is extremely fond of shooting—and of this kind above all others. One evening at dusk when some of the blacks were approaching the camp from the rocks above one of them raised the usual noise to alarm and distract the attention of some animal. So throwing down my skin I rushed to the tent for my gun and just as a wallaroo which had slipped down a rocky gully and on emerging was crossing a ridge going from me at full speed. I fired hastily but not the less correctly, as on going up to look if there was any blood I found the beast itself lying on the

very spot still breathing but done for. The distance was found to be 75 yards—a long shot for a No. 2 shot cartridge to *kill* an animal as heavy as a sheep. So you see, the wallaroo even came to me. So next morning, before breakfast, as Wilcox took a spell at the camp that day, I went to return the visit. Although alone—the blacks not liking to turn out until the sun was well up—for the mornings were cold and frosty, I managed to catch a wallaroo asleep—about as difficult I imagine as in the case of a weasel—and whistling roused her to meet her fate. Within an hour afterwards I suddenly started 2 fine big ones—like the first—(for curiously enough we saw not one young or half-grown wallaroos—all were adult or nearly so). They had been basking in a secluded hollow near a dead tree amid blocks of stone and grass trees and low bushes in a place where they had the full benefit of the morning sun. So I pitched into them, right and left, and if there had been a third I believe I would have killed it also with my third or rifle barrel, because snap shooting is that in which I feel most confidence in myself. While skinning them I took the opportunity of getting a number of specimens of a curious dipterous insect, like those on owls, kingfishers, etc. It is peculiar to the wallaroo. I suppose on account of the long alpaca-like silky wool, affording firm (indecipherable). However, I am giving too much of a yarn. Suffice we got fine skins for stuffing, 21 in number, of—

Macropus giganteus.—Kangaroo, ♂ and ♀.
Halmaturus ruficollis.—Wallaby, ♂ and ♀.
Osphranter robustus.—Wallaroo, ♂ and ♀.
Osphranter Parryi.—Grey face, ♂ and ♀.
Petrogale penicillata.—Rock Wallaby, ♂ and ♀.

Also skulls of all the above and of Halmaturus ualabatus—the last of which—a *very* large male—had the ears so torn, probably by a series of combats, as to be unfit for a skin. Besides, we saved the skins of all the others with good fur, and brought in with us to be eaten 2 carcases of wallaroo and 3 tails of do. for soup. We had killed in all 42 head of large game. Even on our way back we had a grand opossum hunt and a splendid run with the dog, but as my mare carried saddle bags filled with heads I could not push her so as to be in at the death. After a fortnight's fine weather it commenced to rain as we were unloading *at home*. As I think I have said quite enough about kangaroos this time, I must conclude for the present until Sunday and go on with my work meanwhile.

Friday Night: We have completed stuffing the batch of mammalia much sooner than I anticipated, and they make a magnificent show in the verandah—19 in number—for we left out 2 which were wanted for another purpose. I do not believe that any skins of mammalia got and cleaned in the bush and, of course, much knocked about ever surpassed them—in fineness of fur (it being winter time)—in carefulness of preparation—even the feet being skinned and sewn up—and in the filling *naturally* and finishing off. And *now* that all has been accomplished in a manner perfectly satisfactory to W. and myself, I feel pretty sure that ere long we shall have another go in for these creatures—skeletons chiefly this time. I do not know anything about how the Adelaide Museum is supported, but as you correspond with Waterhouse, we should be much obliged if next time you write you would say we can supply him with wallaroos, etc., skins, skulls, and skeleton. Only *some* of this lot are for Melbourne, as Wilcox sup-

plied them and the Sydney Museum before. I have picked out the birds you want and some sterna which we send as before per Agnes Irving. On looking over the skins to-night, I see that the ♂ of *Ptilon. Ewingi* is considerably brighter in the colours, especially on chest and under tail coverts than the female. In Cinclosoma neither W. nor myself ever could detect any sexual differences. The spots occasionally differ, but as in Pitta I have sometimes seen an unusually finely coloured specimen turn out to be a female.—Yours truly, John MacGillivray. July 9th.—I also enclose 2 trachiae of Geronticus—old and young. The *Melithreptus* of last trip turns out to be *albogularis*."

These last two lines are added at the front below the address, the space after the signature being filled with a small account headed "Sundries No. 11".

The next letter reads:—

South Grafton, July 28/65.

Dear Sir,—

Yours of the 17th instant reached me in due time and, as I am in the way of writing to-day, the steamer being overdue, I may as well pen a few remarks, as there will be a little parcel of sterna for you. The two Australian species of Eurystopodus I have frequently started from the ground under bushes in various parts of the N.E. coast, but never found the nest. Of *Dacelo Leachi*, however, which you also mention, I got the eggs at Port Curtis, on Facing Island, opposite the settlement not then in existence. The nest was scooped out of an ant's nest on a tree just as with our jackass here. The two fine Cape York kingfishers—*Tanysiptera Sylvia* and *Halcyon Torotoro* (flavirostris of Gould) I found during my last visit to that place breeding in the large ant hills, the former abundantly, but of the latter I got only one egg. Of the long tailed one I have had a basketful brought me at once together with live specimens caught in the holes. Of *Mycteria* we have not got a skin. That of which you got the sternum was unfit for skinning, but the skull now forms part of the collection and looks well alongside of the pelican. The cold weather is unfavourable for macerating heads, consequently I have not done much lately in the skull way and the No. 1 collection is at present stationary at 105 species, and No. 2 at about 60. The 15 heads of mammalia, however, that I lately got, have now been cleaned and look well. I am glad you mentioned to Waterhouse about the kangaroos. There was a long notice in the local newspaper about them, and in consequence we have had many visitors; I expect a large batch shortly, according to notice. A small flock of spoonbills lately appeared on our swamp. I was out shooting ducks on two occasions and saw them but could not get near. Wilcox got closer on horseback and told me that he thought some had yellow bills. So I went out specially next day, my gun loaded with 2 cartridges and a bullet. As I could not at all get within shot and there was no shelter whatever, I managed to separate the long line when they were seated, and a straggler in making a sweep to join the others forced me to fire as my last and only chance, although apparently a most absurd one. However, I got it, but it was the *regia*—nor, although, I was anxious to determine the point, was I ever near enough to see the colour of the bills of the rest which flew out of sight and I have not seen them since. Ibises have not yet left—nor have the stilts, but as the days are now getting warmer I suppose they will soon be off. I have not been shooting much lately, except for the last 2 or 3 nights at bats, of

which I got *Scotophilus Morio, Sc. Gouldi, S. pumilus,* and *S. nigrogriseus.* Formerly I had obtained *Oligotomus Australis* (a new species and supposed new genus), *Nyctophilus Gouldi, Rhinolophus megaphyllus* and *Rh. aurantius.* The only opossum mouse (*Acrobata pygmaea*) I have seen here was found yesterday morning drowned in a washing tub at a pool 200 yards from this where I have caught many a fine eel and shot many a bird beside ducks. When sitting there in the warm weather cleaning skulls I have been interested to see the birds from the bush adjacent coming down to drink. The Chalcophaps was my favourite, and seemed a very thirsty sort of bird, paying oft-repeated visits, as I would not shoot it *there. Saturday night*: Yours of the 24th arrived to-day. You are quite right I find about Oreocincla versus Cinclosoma. The skins sent were certainly *Oreocincla,* as is also the sternum—that of a male I find by my list. The ground thrush is a quite different bird—which I have shot in Tasmania and at Brisbane Water—the sexes also vary very much—the female wanting the black band and black throat and in Oreocincla they are alike. The Cinclosoma hen I have seen only during our late trip to the mountains. The best way will be to make the pair of thrushes sent you in a parcel and directing them to Wilcox give them to Underhill. I'll make up a fresh account for him and enclose for you a copy so that there will be no mistake on either side. Since I wrote the previous part of this *Platalea flavipes* has turned up and I send the sternum. To-day I shot among other things a *Plotus Novae Hollandiae,* but defer skinning it until to-morrow. I got also the best straw-necked ibis of many shot since they appeared here. Another *Platalea regia* of which I have kept the head and will send sternum next time and in haste.

I remain, Yours truly,

JOHN MACGILLIVRAY.

In the notebook is pasted the draft of a note as follows:—

"ON OLIGOTOMUS, A SUPPOSED NEW GENUS OF BATS.

While residing in the Clarence River district of New South Wales I procured specimens of a bat which at first was supposed to be an addition to the six species of *Scotophilus* described as Australian. On more careful examination, however, the dentition was found to differ remarkably from that of the latter genus, for the upper incisors were seen to be only two in number and not four, nor were the molars furnished with the characteristic acuminated processes of *Scotophilus.* The genus *Nyctophilus* as originally characterised by Leach is stated to have only 2 incisors in the upper jaw, but the type of the genus N. Geoffroyi as well as N. Gouldi of Australia with which it was long confounded are provided with nasal appendages. In Tomes' Monograph in the Proceedings of the Zoological Society for 1858."

Afterwards in the notebook the following was added:—

"Oligotomus. ♀ February 12/66.

Colour on shoulders, back and flanks where the fur is long and silky, of a fine chestnut, mixed with a few pale hairs, fur of head shorter, rather more inclined to grey, grizzled with pale hairs, whole of lower surface fawn coloured.

Snout to end of tail, 5½.

Tail—bare portion only—1.6.

Forearm, 2.1.
2 and 3 phalanges, 2.0.
Leg, 1.0. Extent of wings, 14½ inches.

Hair on sides extending on the wings almost to a line between the knee and elbow. Ears very widely apart.

This individual was flying earlier in the evening than usual and with an unusual hovering flight."

Many notes were added giving details of the genera of bats as he received them from his correspondents, some pasted in as received. Little pencil drawings of the heads and details of the ears and teeth also made by MacGillivray suggested that he had inherited his father's facility with the pencil. In every case great care is shown, again suggesting his father's skill as the father was called "the accurate MacGillivray" by one of the hardest critics of his time.

To continue with the letters:—

Grafton, August 9th, 1865.

"Dear Sir,—

I have only a few sterna which it is scarcely worth while to send. The new ones I may take down from the list on the wall opposite my seat—

Fulica australis.	Plotus novaehollandiae.
Podargus megacephalus.	Pitta strepitans (2).
Herodias plumiferus.	Lobivanellus lobatus.
Graucalus mentalis.	Ichthyaêtus leucocephalus.

Astur novaehollandiae (albino).

Regarding the nidification of the spoonbills of Australia I know positively nothing. It is only here that I have seen the birds alive. About bats it is only lately that I took to getting a few and we have only 4 species of Scotophilus, viz., pumilus, nigrogriseus, morio and Gouldi. Previously we had sent some to Melbourne, including numerous specimens of a largish one not belonging to any recorded Australian genus. The dental formula agrees with *Nycticejus* and it may belong to that genus. I shall soon know, however. I had described it minutely and provisionally called it *Oligotomus* from the small number of its cutters. They had it previously in the Sydney Museum marked and published in the catalogue as *Vespertilio macropus,* a bat to which it bears neither generic nor specific resemblance. You ask about one with the tail produced beyond the membrane. That is *Molossus wilcoxi.* It occurred once before my arrival here and has not been met with since. Several were found together in a hollow tree. I could not undertake to procure it.

. . . However if you want bats it is right to mention that unless specially ordered all we have on hand will be sent to Melbourne Museum next time we make a consignment which depends on advice from Professor MacCoy—now overdue—regarding our kangaroos, etc. . . .

On this day last year (August 9th) I entered into an agreement with Wilcox which I have acted upon for one year. I am not satisfied with the result and when we square up it is not likely that I shall remain here. . . . I have just been out taking a turn with the gun. Two ibises were in the paddock and I could have shot them with cartridge from my window. A flight of flock pigeons came into the big fig tree where also I saw *Sphecotheres,* which has I think been absent for a while. You wanted a ♀ so I shot one. I am now going across the water so conclude and remain."

Grafton, August 29/65.

"Dear Sir,—

Yours of the 23rd was received on my return from a trip to the Urara for Helix, etc., and since then I have been so unusually busy that I must defer sending the things until next steamer after this one. I must also postpone answering some points in your letter until then. You are, I must however mention, mistaken in including Lopholaimus Antarcticus under "old prices" as I never had a specimen in the collection until lately as the only one I got last year went for a skull. . . . It is now dark, although moonlight occasionally, and I have to cross the river and after calling at the steamer with letters go a long way out of town to see a sick friend whom I am doctoring as he was improperly treated by one of our medicos in the first instance and begged me to take him in hand which very reluctantly I have done, and in haste, believe me."

This recalls the fact that he was studying medicine and had nearly completed the course when he forsook it to take the chance of naturalist for Lord Derby on the "Fly". It is quite commonly asserted that he was only eighteen at this time, but as this took place in 1842 he was fully twenty, having been born in 1821.

Grafton, September 8/65.

"Dear Sir,—

I wrote very hurriedly by last steamer and I now more leisurely continue the subject. The two tracheae without labels I find must be of *Geronticus spinicollis* sent in No. 11 on July 11th. Of the three birds you want I can send only *Lopholaimus antarcticus* ♂. It is a showy bird and, although common enough in this district at times, I shot only one last season and consigned its head to the skull pot. The ♀ *Sphecotheres* I should have got while the birds were here, but somehow did not do so. They are now absent, but will arrive soon and breed as they do every year in certain cedar trees near the house where I *saw* four or five nests which were not molested. Even should I not be in Grafton at the time they will be looked after, but I am almost sure to be back before they have eggs. *Eurystomus* will be here soon also. I knew several nests in spouts in our paddock, but there was no black about at the time to send up for eggs. *Podargus Phalenoides* may never occur again to me. The only specimen we had is now, I suppose, on its way to Europe in a collection. You speak about eggs of *Menura superba*. Some months hence I anticipate going to a place in this district where this bird is found, but the egg season by all accounts is long past. You do not allude to *M. Alberti*, the season for whose eggs is also past. *Psophodes* has young now, I suppose, for I yesterday saw in possession of a boy I know a young coachman which he had caught after a long chase and which he will probably succeed in rearing, for it was quite uninjured. *Orthonyx* I also know to have young, for on Tuesday last while searching for a thrush which I had shot I disturbed a young spinetail which ran and flew off from near my feet calling out loudly when in a moment it was joined by an adult bird, which I naturally supposed to be its mother, but which on dissection proved to be a male. The nestling was so curious in plumage that I skinned it. It crept under a tuft of grass and was killed with the shot fired at the old one which was watching it. The young coachman, I may mention, has no white on the sides of the throat and neck as in the adult. I have lately on Monday and Tuesday been in a scrub where

I saw and procured several fine specimens of this bird, common enough here but difficult to shoot. Talking of this scrub, had there been any Sphecotheres in the district I would have seen them there with the other birds feeding on the berries of a certain tree. The orioles were a perfect nuisance. In one good tree there were about half a dozen which pitched into every other bird which came near except the regent birds—females and young males I mean—for they mobbed a cock immediately on its alighting on a top twig, and had I not been quite ready I might have lost it, and, while re-loading, the noise above and chattering broke out afresh, and on looking up they were seen to be having a set-to with a black satin bird, and after giving *this* its quietus I had serious thoughts of shooting all the orioles as a nuisance. The dull coloured satin bird gave way to them at once as readily as the little *Ptilotis chrysotis*. Among the sterna this time is one of *Sphenoeacus gramineus*, the sex of which is marked ?, for I could not determine it by dissection. I have the skin, however, but do not know the *outward* sexual distinctions—if any. Talking of scrub birds, *Pitta* must be breeding now, judging from the condition of the inward of them I have lately shot. The last one very foolishly began calling out when I had been looking for it on the ground, and a little way up, for this directed me to the bird, about 15 feet from the ground, among some foliage, an elevation I had never seen it attain before. About getting sterna "so white and clean", the latter part is of course the result of patient picking with the scalpel and scissors, and the former I never trouble myself about at all. I sometimes, indeed usually, when skinning at night, place the sterna as roughly taken out in my basin for the night and clean them in the morning. At other times if I have time I clean them right off without any maceration whatever, except a washing, and hang them up in the verandah to dry. Of this the sternum of *Orthonyx* now sent is an instance; for not more than an hour elapsed from my taking it in hand until it was put away in a box with a label attached. However, maceration followed by bleaching in the sun will make sterna as white as may be considered requisite. Salt added to the water helps to extract the blood, and the grease may be removed with potass, but I never use either now. Were I preparing *skeletons* the case would be different. If blood is once effused in the cellular substance of the bone it cannot I believe be removed. As for skulls, I put the heads—minus skin, eyes and tongue—into a small covered jar, which I keep beside a log out of doors on account of the smell, and about once a week I clean with scalpel and syringe, such as have been sufficiently macerated. *In warm weather* a week or ten days is sufficient time, but the day before yesterday when making a delivery I found that some heads which had been in water for *two months* were not ready, while others not more than two weeks in water were cleanable. I don't shift the water at all after putting the heads in. Wilcox and I with a blackfellow start for the Richmond on Monday. We take a light cart and shall be independent of house accommodation. We make for Lismore (passing through Casino) 70 miles from this and shall locate ourselves in such of the cedar brushes as we find to be suitable for our purpose. Having horses we can make long journeys in any required direction without breaking up our camp. And on our return Wilcox goes to Melbourne, instead of going by next trip of Urara, as was at first intended, and it will not be until his return that I can make my run down to Sydney. It is, of course, useless to speculate on what we may get, but this much is fully certain, that we shall bring back a cartload of specimens of some kind or other, unless prevented by accident or

other untoward event. And if everything else fails we might do a little business in the bushranging way, for we are not known there and will be provided with good horses and first-rate guns. I have just been out with a light to look at a nest with 2 eggs found to-day in a banana plant. The nest is dome-shaped, well lined with feathers. Egg (one which I removed) of a stone colour or French grey ground with a corona of umber brown or darker still outside of which and elsewhere on the egg are minute freckles of same, but showing a faint reddish tinge. I don't know what the bird can be. However, to-morrow and Sunday, I'll look occasionally in hopes of seeing and shooting the bird. Any communication during my absence will be forwarded, as there is a weekly post hence, via Casino, Lismore and Ballinah, and we shall make suitable arrangements. If you want any birds it will be as well to be in time as there will be a *complete* clearance on our return to make room for the turning over of a new leaf."

The mention of "bushranging" indicates that MacGillivray had a slight sense of humour, which was rarely displayed.

Per Grafton, December 14th.

Grafton, December 10th, 1865.

"Dear Sir,—

Your last of September 13th arrived here when I was absent and I did not get it until two months afterwards. Before alluding to my trip to the Richmond, I shall first notice some points in your letter. *Menura Alberti* which you wanted we did not get at all. We had intended devoting a week to it in one of its haunts, but were disappointed by the person who was to take us to the place. I heard it call occasionally and once saw one for a moment in the dusk of the evening running across a drawing road. The eggs you speak of we did not get. An *Orthonyx* nest was shown Wilcox by some boys who had taken out and broken the eggs the day before. The coachman builds a domed nest on the ground against a tree or on vines a little way up. One sawyer who collected birds at one time for Palmer had several times seen the nest, and a man whom I met at a place near Lismore told me he *then* had one in his garden with 2 young ones. Had he said eggs I would have gone to the place, but I had been out all night in the bush and did not feel much inclined to turn back merely to look at the nest. I myself found an empty nest answering to the description exactly, but had to pull it to pieces getting it down. It was nearly or quite completed. Eurystomus and Sphecotheres are now—I am informed—breeding about the house as last year, and I suppose I shall get some eggs of both, but I have not had time yet to look about. The first time I take the gun in hand (I am heartily sick of shooting at present) I must get you a female *Sphecotheres*. The Monarcha you speak of is probably *leucotis*, described and figured in the Supplement to Gould from specimens procured during the voyage of the "Rattlesnake". I shot it as far to the southward as Dunk Island, and I daresay its range extends as far as Port Denison. Of eggs again, I may say that we got scarcely any. Two of Melithreptus albogularis which I found on our outward journey were put into the dray unblown and half an hour afterwards were smashed by the only capsize we had. The nest I afterwards used towards filling a pademelon of an undescribed species by the bye unless it is the one which Masters told me Krefft was going to describe and call after him. Pardalotus melanocephalus we got about a dozen eggs at one of our halting places on the road. Nest and eggs of

Rhipidura motacilloides, magpie, titlark, spurwinged plover, Ptilotis chrysotis, and a nest and egg of *Sericornis citreogularis*. I saw the bird fly off this. The nest is extremely curious, the whole structure measuring about 2 feet in length. I got another pensile nest of a different construction with 2 eggs, but did not see the bird. The eggs were nearly ready for hatching, and are longer and more pear-shaped than in the other. The colour is different, but the same as one I got last year in a very different nest. There is no other bird I know of which could have made a nest of this kind with so large an egg bigger than any other Acanthiza or Sericornis would lay. I believe they are all the handiwork of *S. citreogularis*. Of these pensile nests I have seen from a dozen to twenty or more in a day when in the cedar brushes after rifle birds. I shot down some, only one of which *Sericornis frontalis* had eggs (5), but the chicks were so large that I could not blow them. The old nests probably hang for years, for no wind can reach them. On the last visit, however, which I paid to the brushes in order to get two more rifle birds to make up my number, I had a horse, and as both were by the side of drawing roads, many years ago, there was no difficulty in conveying them back to the camp, and I put them in the bottom of a can with large shells packed in moss so that they reached home in good condition. Talking of shells, we made a noble collection, and there are several species which I at present believe to be new. The largest are Falconari and Richmondiana. We made a fine collection of insects, at which I am now working, making up three ordered sets. Of birds, of course, we got plenty, but as our chief object was to get saleable ones, we chiefly looked out for rifle, regent and satin birds, shooting dragoons and lories and the like when they came in the way. A remarkable little bat is quite a novelty. Of the birds the most remarkable one is an *Atrichia* which may not be *clamosa*, so I do not send sterna until that point has been settled. A *Sphenoeacus* is in the same predicament. I never saw Mirafra alive before. It is a beautiful songster, more sky-lark like Cincloramphus and greatly its superior. Four which I shot one day were all males. I could not attend to sterna. I had so much on hand at all times. I lost a lot in a water hole which dried up, and allowed some creature or other to take them away. It is very well to clean sterna when you have water in plenty, a basin, and a house. Of the first I had sometimes none to spare. Not enough to drink, especially during upwards of a month when I was alone (for Wilcox left me there and came back again), and of the 2 other never had either. Last night, for the first time for 3 months, I slept in a house. I got some fine ferns for my sets, and altogether am very well satisfied with my success. As soon as things can be got ready will clear off at Melbourne and begin afresh and meanwhile in haste."

This is the first mention of the now famous *"Atrichia"*, which recurs in succeeding letters, and it may be noted that the specimen Ramsay secured became the type.

The brief account of the hardships undergone on this trip hardly suggest the strain on his weakened constitution, which led to his untimely death eighteen months later.

Grafton, December 24/65.

"Dear Sir,—

Yours of 18th inst. was received yesterday. I might pack up to forward by the "Grafton" the birds' skins you mention to which I have added a female *Sphecotheres*, a bird about which you repeatedly inquired and which

I got as soon as I had leisure after my return from the Richmond to go out with the gun. I also shot a young male just assuming the adult plumage, and from the condition of the testicles I judge it had paired and had a family. I have been too late for eggs of Sphecotheres. I induced on three different mornings 2 blacks and a gin to look for eggs, but all the nests had young ones, although one besides 4 newly hatched young contained an egg with a large chick. With much care I managed to extract the youngster and the egg is a good enough specimen with a large hole. However, as the egg of *Sericornis citreogularis,* which you wanted, and which cost me a great deal of trouble to procure and bring here (with the nest), is not wanted now perhaps Sphecotheres egg is in the same predicament. I have lately—for the first time here—procured the female cowhat. Of this bird we formerly had males only, including one most remarkable specimen which had . . . about one half of the black feathers of the adult male. You frequently directed my attention to the *Anseranas melanoleuca.* Yesterday I shot two, one of which was a very fine gander, weighing 6 lb. So I thought I would skin it, although in a woeful plight from the mud through which I had to chase it and where I very nearly got bogged. My companion —a friend of mine, who gives a grand dinner on Boxing Day—coveted my gander, so I gave him the goose, a very large swan, and a lot of ducks—for we had two horse loads of game, and I might have got more if inclined, but I took little interest in the matter and none in the shooting. By dint of washing with soap and plenty of water and a brush the bird became all right. . . . The tracheae is extremely remarkable on account of its great length and convolutions between the skin and the chest. As for shells for W. Denison, of which you want 6 or 7 species, as I have not the slightest idea of what is wanted, it is useless to send any. You can have fine specimens of *Helix Falconari, H. Richmondiana,* and *H. Bidwilli, H. mariae,* a small undescribed *Pupina* and a *Helicina,* which I also believe to be new. There are many other kinds as *Porteri, mansueta, ammonitoides, Moretonensis, ptychomphaea,* etc., but we have none of these for sale except in lots. There are three kinds of *Unio.* We are awaiting a reply regarding shells from Dr. Cox with a view to sending a quantity to England where at least they will be appreciated and fetch their value. They have not been got without expense, and a large amount of labour of which shell purchasers in general know little and care less. However, this is Christmas Eve, and I have been at work all day and must conclude."

"N.B.—The young ♂ rifle bird is the fourth mate taken by a female whom I widowed as many times at various intervals, extending over a period of two months. The first 3 were full plumaged, the last as you see. Yet it called a loud double note like an old male, and I saw it on the *same* large bough on which I had shot two of its predecessors, going through the usual antics, minus the rustling noise of the wings, which its wings could not accomplish, although the bird tried it. Other instances occurred to me to make me certain that sometimes at least the male pairs in the second year.

"*December* 26th.—The parcel goes on board the 'Grafton' to-night. A black has been looking for Sphecotheres eggs this morning—some young, but no eggs."

Grafton, March 25/66.

"Dear Sir,—

Your note of the 15th instant reached me yesterday per "Urara" and I reply by same steamer. Also, according to request, I forward such speci-

mens as you ordered in a previous letter, viz., sterna—eggs of *Pardalotus melanocephalus* and of *Ptilotis chrysotis*. Of the former I have not now a dozen, so send only 8. Of the latter I did not say anything about the *nest*, for I well remember having used it for filling out a skin and send the 2 eggs only. I saw the bird on the nest frequently. Your answer about the egg of *Sphecotheres* was too late, as well as your offer about the nests and eggs of *Sericornis citreogularis*, to which, however, we could not have acceded. *Sphecotheres* this year did not breed as last in the small cedars near the house, and I had much trouble in getting even one egg. So much so, that, although I afterwards saw 3 nests in a cedar in the touch of untouched brush, I never had curiosity enough to re-visit the tree. The blacks come and go in a most uncertain manner. Yesterday I was fortunate enough to get some in the humour, and took 8 away with me in the boat to a reserved island in the river to hunt for the brush opossum, a series of which—the grey and black—♂ and ♀, I wanted (and got) for the Adelaide Museum. I got a nest of *Donacola castaneothorax* the other day. This I enclose in the parcel, as probably you have not got one so perfect. There were 6 eggs, but as this bird has for some years back been as common a cage bird as any of the "Rockhampton Finches" to be seen by hundreds in the market, and breeds freely in captivity (as I have seen in the Botanic Gardens), you have doubtless got some. I send a few sterna as per list appended. None of them are very recent, as I have given up preparing them, having got as I thought 100 kinds, although I now find I am a few short of that number. Still, although I have got even too much to attend to, I would undoubtedly save the sternum of anything very curious that might turn up. That of the Richmond River *Atrichia*, which contrary to my expectations agrees with Gould's description of *A. clamosa* from Western Australia, is very singular. In habits the bird resembles the coachman. We got only 2, both males. One goes to Adelaide, being on the extensive list of things ordered there; the other will go to Melbourne, along with all our best things, to the Intercolonial Exhibition. Both Wilcox and I are on the Grafton Committee, and our joint contribution will at any rate make a respectable addition to the Clarence River Products, while it will answer our purpose very well, as the lot will not come back again and I shall have plenty of room for the new stock. It had been intended long ago that Wilcox should take our things to the Melbourne market, but he never could see a clear chance of getting away for a month, so tied up is he here. And with myself, although I was in hopes of having a run down to Sydney for a week, and even now when I have an additional and most urgent reason, viz., to get medical advice, I am afraid I shall not be able. Next month I *must* go for 3 days to the Nymboida to get a fine specimen of the Murray River Cod, and I *must* go a week to the Urara Mountains for a grand kangaroo hunt to get flat skins, and my visit to Sydney seems again to be further off than ever.

As we have a commission of importance for some Richmond River things, I shall probably take a trip thither in June-July, when the *Menura Alberti* (some of which are ordered) is in the best plumage and is breeding. It will be extremely difficult to find rifle birds then as the cocks will not be calling. The insects paid us better than anything else, and we have now on hand a *third* order for Richmond Coleoptera from Castelnau, besides having supplied Mr. Macleay with a set and the Melbourne Museum with another, including *all* our specimens of the remaining *opteras*. I little thought at the time the beetles would have turned out so well and am glad

they were not neglected. But I must hurry to a conclusion, for I have not finished my opossums—although the day is Sunday and I lectured last Friday "On Missionary Life in the South Sea Islands"! So conclude.

Grafton, April 15/66.

"Dear Sir—

Your letter of March 29th received the day before yesterday. Having been from home for the last two days and having shortly to cross over to the other side to the steamer with letters and being also very unwell, I do not feel quite up to the mark of writing a long letter, so that this will be a short one. *Atrichia clamosa* is 15/- a ♂. The other specimen has gone to Adelaide. Gilbert got only males in W. Australia. It seems there to be extremely difficult to be procured, and Gould says Gilberts' specimens were much damaged by having been shot close at hand. The Richmond bird agrees with Gould's description and a tracing of the figure sent me; still, I cannot help thinking that some differences will yet be found to exist. I am certain that Gould would find little difficulty in making a species of it. I hope to get a few more when I go to the Richmond. On two successive evenings I watched for this bird which was calling within a few feet of me, but it was too dark to see it. I have not got *Calamanthus campestris*. The last skin of *Talegalla* has been sent to Adelaide, and we have none of the eggs. The last I saw were on the Richmond in December last; they were eaten. I shall have some skins soon, I believe. *Cladorhynchus* is a bird which has never occured to me in a living state.

The lithographed plate of eggs seems to be highly satisfactory. You will find in the British Museum a good many kinds of Australian eggs of my getting. The last batch I collected—chiefly at Cape York—were sold by Cuming for upwards of £32. If I remember rightly, Gould bought some, but probably not for himself. *Ptilotis filigera*, *Halcyon Torotoro*, *Aplonis* and *Tanysiptera* were among them. Of the last I have purchased a basketful. Jardine, the P.M. at Cape York, says it arrived there the year before last, on November 30th, from New Guinea, after a storm of N.W. wind, with rain, as the natives informed him would be the case. They had years ago informed me that it breeds in the big ants' nests, and I had the satisfaction of verifying the fact. I skinned some which were brought me *alive* and in much better condition than shot specimens. Jardine states in his published report last year that his collection comprised upwards of a hundred species of *land* birds. Doubtless some were new. A fine collection formed by the surgeon was lost in the ill-fated "Fiery Star". I was very much amused with the perusal of Jardine's report on finding that nearly the whole of it was borrowed from an old published one of mine to which he refers. The arrangement even is the same, and whole sentences are given almost vevrbatim. I never even heard of Gould's Handbook until you spoke of it. It is not very likely that the Victorian Menura is a good species. Two cedar cutters who reside at a mountain brush about 35 miles from this have been telling me that they hear the pheasants every day. From the description of the tail feathers it is certainly *superba* and not *Alberti*. I have promised to go up to their place in June and hope to go to the Richmond immediately afterwards. But if I can carry out only half of my intentions I shall be content. Obstacles are perpetually occurring. I have sent Waterhouse specimens of 16 species of birds which were among the desiderata. Also a fine lot of skins of mammalia. I expect another order

from him soon. We send 130 species of birds to the Melbourne Exhibition. Yet very many of the commonest kinds are unrepresented. My skulls have stuck at 120 species. There are about 80 species in the second set. I hope to get rid of the whole lot at once, and then I won't trouble myself again with them. Mammal's skulls pay better, and I have supplied Melbourne Museum with many fine ones. However, I must now conclude."

Grafton, May 7th, 1866.

"Dear Sir,—

Yours of 19th ult. was duly received on my return from a week's trip for the purpose of obtaining a specimen of our cod perch, which is specifically identical with the far-famed Murray River Cod of Victoria. In this we succeeded, as Wilcox caught a fifty-pounder, which I have stuffed, intending it as the representative of the fishes of our district in our contribution to the Melbourne Exhibition. We camped on the Nymboyda or Mitchell, a tributary of the Clarence, at a place 36 miles from this. There were 8 in our party (including 2 blacks), of whom our P.M. was one. You seem not to understand the meaning of these letters—simply Police Magistrate (not Mounted Police). It had been in allusion I suppose to Mr. Fawcett of the Richmond that I had formerly used these letters. Our P.M. is Captain Hill, a great sportsman, and to be hanged to him, for I have not yet forgiven him for causing me to ride 30 miles the other afternoon in 3½ hours in his anxiety to be at a friend's station in time for dinner. I didn't feel very lively next day, although I had got a fine bat (Rhin. Megaph.) in the room during said dinner and during said ride the dogs caught a kangaroo rat of a kind I had never seen before—Bett. Grayi. Of course, I skinned it. Our fishermen were highly pleased. They caught 25 cod, the second largest of which weighed, when cleaned 32 lb., besides some enormous eels, and one of them had good sport with the rod fly-fishing for herring (Myalops retipinnis). We had kangarooing, of course. But to me—better than all—the sleeping out stopped my cough! As for *Atrichia,* I think you will find that the bird has or had only a *rudimentary furculum.* Such was my opinion at the time. I noticed and remarked to Wilcox—who distinctly remembers it—that in a bird otherwise so similar to *Psophodes* there should be such an important diffference. I cannot *now* give you the colour of the iris or write an account of the habits. You think the price is high and expect the skin to be very good. I differ entirely about the price of this very rare bird. The specimen is not very good, having had the plumage ruffled by carriage and not having been put to rights, as it was of course intended to be stuffed. And I know what Gould says of the bad condition of Gilbert's skins of this bird which he had to shoot from the distance of a few feet only. However, if not satisfied, strike the price out of the bill, for I know a person in Sydney who will be but too glad to get it. I have reason to believe, from information lately received, but I speak without being positive, that Masters has got the *Clamosa.* I also believe that the Richmond one will prove to be different, although Gould's description agrees with it as far as it goes. You ask about the *Sphenoeaci.* Of *S. gramineus* I have one specimen (of which you have the sternum). It is the only example I ever met with here. Nor have I seen *Galactotes* at all for many years. I have shot both to the northward, I know, but I have not a very distinct recollection of the circumstances, so cannot say anything about them at present. I saw a good many lories and rosellas when

I was last away, but had no gun, because I did not wish to divert my attention from the main object. I will look out some skins in the morning and conclude this then. Gould's new book I do not care about at present.

Tuesday morning, 8th May. I have looked up the skins, but find only one ♀ rosella, so that I shall have to get. The steamer I see is about to start, so I have not had time to label any of the things. But this is not of consequence."

Grafton, June 3rd, 1866.

"Dear Sir,—

I would have answered yours of the 24th instant by same steamer had I not been extremely pressed for time, for, besides 4 kangaroos and a sea eagle on hand, and in process of preparation, our exhibition on the other side of the water had to be attended to—packing, etc. We had it open for 5 days, during which time about £25 was taken at the doors, and I was not sorry when it was over. Of course, I was stuck in for the lion's share of the work, including even the preparation of the long newspaper report, and an address or lecture at the close, besides arranging labelling, etc., etc. All these services were gratuitous, and our own business suffered materially, as we have many orders to execute. Of these kangaroos there is a splendid pair of grey faces (*Halmaturus Parryi*) and a new species near *H. ruficollis*, but very distinct. A fine old man, almost, if not quite as big as that exhibited, and which goes with its mate and the grey faces, and a pair of wallaroos, the eagle and a jabiru, to Adelaide concluded the lot, and we expended an almost fabulous amount of corn husks in the filling. Wilcox is now away for a few days after large animals with 3 horses and a black and, as on his return, probably to-morrow, I shall have several days' hard work finishing and filling such skins as he is sure to have I take advantage of a little leisure, the first I have had for a long time back; to write this. I yesterday arranged with a sawyer (an old shipmate) who lives among the mountains beyond Nymboida, about 35 miles from this, to spend a week with him a fortnight hence for the purpose of getting if possible a few lyre birds for which we have orders, among others from the Paris Exhibition Commissioners, to whom we shall send the first batch of skins next steamer. The Menura is the Superba, and the birds now, I have been informed, are unusually noisy. One of us will have to go to the Richmond for Alberti and one or two other things. Although the *Atrichia* agreed sufficiently with Gould's description as sent me by Krefft and Waterhouse, there were no measurements to guide, nor had I any means of comparing it with clamosa. Waterhouse got the other specimen, also a male, and marked in *precisely* the same manner. He wrote to Gould telling him of a *new* Atrichia and most likely sent him the skin also, although he had not done so when I last heard from him. There is not the slightest doubt in my mind as to the fact of both being adult birds. They were both noisy enough, mimicing Sericornis citreogularis and several other brush birds, besides having a note peculiarly their own, which I have listened to. Wilcox shot both of them. I have no note of the colour of the eyes. I have been obliged to give up all thoughts of being able to carry out my long cherished wish of taking a run up to Sydney and, instead for several months, I have before me the prospect of plenty of work, much of it of a disagreeable kind, for I hate skinning. I have not cleaned a sternum for a long time back, except that of the Jabiru, which goes with the skin to Adelaide. Yesterday I did not

even save the sternum of an eagle—a very grand old female, the skin of which does not exhibit the slightest vestige of blood, grease or dirt, although the bird fell into the swamp in a muddy place and presented a most woeful appearance with blood and mud. I washed it but gave it up for a bad job, but Mrs. Wilcox took up the matter and by using soda and hot water restored its respectability most thoroughly. It almost looked as if some magical influence had been employed. I never saw a finer specimen, and I have shot at least a dozen, chiefly on the N.E. coast, where also I have taken the eggs two or three times, as well as those of the osprey twice. Pardalotus melanocephalus is now building, and I got nest and eggs of Amadina Lathami a few days ago. I think the little redhead is also building, as it appears to be almost always doing. But I must conclude this and turn in."

Grafton, July 1st, 1866.

"My Dear Sir,—

Yours of 19th ultimo reached me yesterday and, although this is Sunday, yet as the steamer leaves to-morrow, I suppose I must answer it now, as I shall have to be at home all to-morrow from a press of work. Skinned a native bear to-day—completing the group of ♂, ♀, and young. In the first place I feel infinitely obliged to you for the Handbook. I took it to bed with me last night and, having in vain tried to sleep, being very unwell, I read it right through, finishing about daybreak, when the jackasses were beginning. The number of new names is positively alarming, especially those of the New Genera, and I don't know that I shall ever master them. Last week I shot a Melithreptus, larger I thought than lunulatus and having blue and not red about the eyes. I think it is the bird spoken of by Gould, who refers to 2 skins sent him by Bennett and Angas. But I have not had time to overhaul it completely. You are mistaken in supposing that "Wilcox does all the interesting part of the business, shoots, etc." It is only during the last 3 weeks in virtue of a special agreement that he has done much bird collecting. We have done an amazing amount of work very lately—ducks by the flock and black cockatoos by the family (9 in a lot) and so on. I have not had time to attend to sterna. There are about a dozen and a half on the table beside me—but some are duplicates—a jabiru, white headed eagle, etc. Among good ones are the white ibis, yellow legged spoonbill (I killed one of each species the other day, right and left—the black and the yellow billed), Falco melanogenys, the 2 little grebes, etc. I was never quite sure about *Podargus megacephalus* until the other day, when one turned up, and we had recent specimens of P. humeralis to compare with it. It goes to Adelaide in a fortnight, being on their list of desiderata. I heard from Masters yesterday. He tells me he is going to Cape York in September. I should like amazingly to spend a few months there. I feel certain that he will get some novelties in the bird line, and he will get there in good time to catch many birds breeding. About January, I think, the natives will catch any reasonable number of Tanysypterae alive in their holes. This is better than shooting them. I have had the eggs brought me by the basketful! Donacola castaneothorax is now in flocks—or at least there is one large flock near us. I shot a lot last week, but only about 4 were in full plumage. Now those I last shot at Cape York (from a flock) in January or February were all in full plumage. Wilcox shot about 20 at a shot a few days ago, but *not one* was fit to skin. I hope

when Bennett's 2nd edition comes out he will have some more gatherings to add. What you state about the Didunculus is capital.

July 9th. I had not an opportunity of sending this away by last steamer and none has been in for a week back. I think I'll send a few sterna this time if not hard pushed, and the man to take me to the pheasant ground does not come to me before the day after to-morrow. I shot a Melithreptus the other day, which puzzled me. On looking into Gould I thought it likely to be that which he calls *brevirostris*, but on getting out the skin I found to my surprise that it is the South Australian *M. gularis*. A Ptilotis shot on the same day and which I looked upon as Pt. fusca—but the ear coverts are not blackish brown and I cannot see a ring of black feathers surrounding the eye. Our Donacola castaneothorax as I used to call it has the under tail coverts *black* and not white, and the bill instead of being black is bluish horn. I have 4 before me in adult plumage. I went out to-day to look for some fresh ones, but could not find the flock I had seen yesterday (Sunday) when, not having a gun, I startled several hundreds in one flock. However, this last is very likely distinct enough, and I'll look into the matter in all probability some time or other. Have yours—adults—black bills? I have been working away at the determination of a lot of land shel's for S. and W. Australia all this afternoon, and I was forced reluctantly to put them aside for the time—not to be taken up again for perhaps a fornight. Had a shot at a jabiru on Saturday with a rifle and missed him, of course, never having fired or even handled a similar instrument before—Terry's b.l. rifled carbine. Better luck next time perhaps.

July 10th. A steamer has just come in, as I heard her blowing off a short time ago. So I have made up a rude bag to contain a few sterna. If you have an adult Donacola castaneothorax, I should be glad if you could lend it, and when I return it I shall add a skin of *our* Donacola which may be distinct. I have been working at land shells most of the day. If you can spare one each or better still a pair of *Bulimus atomatus* and *Helix Dupuyana* from the Hunter, I shall return some of the Richmond ones in exchange. I have a partial set of shells from various parts of Australia which I keep temporarily for purposes of reference and have not either of these 2 species, although I once had a few of the latter, got some 50 miles or so from this, which went to some one or other. I forget whom.

July 21st. The steamer alluded to above left again quite suddenly and unexpectedly, and besides it rained in torrents and we could have no communication with the other side. Yesterday when I returned from an excursion of several days' duration I found that the Grafton which arrived on the previous afternoon had already left. However, a slow coach—the Susannah Cuthbert—leaves, I believe, to-morrow, and I shall try to get this and a box of sterna sent over to her. We have not had a boat this year at all, although it was part of the agreement that I should have a boat whenever I required one. However, our agreement has been more honoured in the breach than the observance, and I am delighted to be able to state that now I have a prospect of a speedy settlement and shall be able to follow the bent of my own inclination which will lead me many hundred miles away from the Clarence and to the very best collecting ground in Australia. However, I need say no more at present. At our last Committee meeting we agreed to send Wilcox to Melbourne to see the Grafton things

placed, etc., and devoted £25 of the fund to defray his expenses. He leaves this on or about September 15th, on which day I leave this house. . . . . Wilcox takes with him to be sold for whatever they may fetch *all* our collections, and on his return after the opening of the Melbourne Exhibition, and settling with me I leave for Sydney. During that interval I intend chiefly living at a squatting station on the Urara, 10 miles from this, coming to Grafton occasionally and doing a little collecting before returning to Sydney. Our contribution to the Exhibition, which remains untouched, will probably not be sold until its close in January, but this I care little about, as it need not affect my further movements.

The sawyer (an old shipmate), who was to come in for me with horses, has long been delayed by the floods. Even now the Nymboida where he lives is not to be crossed with packhorses. I have long been daily expecting him. He has sent me two messages, certainly, and it is no fault of his. Meanwhile the pheasants are breeding. Yesterday a black (who frequently shoots for me) came to tell me that another black had found a pheasant's nest with an egg and some dark night soon hoped to catch the old bird on the nest as he had left the nest unmolested. My informant—who had come in that day (yesterday) was about to start on his return and tired as I was—and with a lot of birds to skin, if I had had a spare horse for him—I would have gone off at once to try and get the egg. . . . However, I held out very strong inducements to Daddy, and I think he will get the egg. We had a jabiru for dinner a few days ago (skinned, of course), and it ate very well, but could not be compared to a kangaroo rat some days previously. "What's in a name, etc."? I hope my sawyer friend will come down soon as I am anxious to get some pheasants (superba). But I have so much on hand now that I am afraid I shall not be able to go to the Richmond for Alberti, but I'll try when the waters have dried up sufficiently. But I have plenty more to do yet on this day of rest for all my neighbours so conclude."

This is the last of the Grafton letters. The succeeding two were written in Sydney, the second being the last letter now available, and shows MacGillivray to be full of enthusiasm for the future.

Dr. Cox's, Tuesday,
February, 18/67.

My Dear Sir,—

The Norfolk Island shell (there was only one kind in those I took) of which the lot chiefly consisted is *H. insculpta* of Pfeiffer. The glassy one from Ash Island is a var. of *H. rustica* Pfr. The reversed *Pupa* turns out to have in addition to the *two* plate-like teeth, not less than *three* others. It agrees with no described one and will come out soon under some grand name, *Dobroydensis* or *Plough-Innensis* or *Inncreekincola*. The solitary Helix you showed me of which you had seen one of Dr. Cox's specimens at the Misses Scott is not Australian. Cox has a large number from the Solomon Islands. The shell I mean is bristled all over, hence the name *Helix erinaceus* or the hedgehog snail. In haste.

P.S.—I opened this to tell you that Cox has just shown me the last part of Zool. Proc. Gould has made additions to the birds. The new ones are. They were collected by the late Jardine, it is supposed—

Gerygone personata Gould.
Ptilotis gracilis Gould—like chrysotis.
Monarcha albiventris Gould—like trivirgata.

Also add from Cape York, not in Handbook.
Rallina tricolor G. R. Gray—originally found by Wallace at the Arru Islands.
Hydrochelidon leucoptera Meisn. & Sch., formerly assigned to Celebes.

J. E. Gray has described the pademelon of Cape York as new. He had it from me 13 years ago and named it—a very large male—*M. agilis* in the Museum. But nowadays people do queer things. There is, of course, a new rat *Mus macropus* with very long black whiskers, the body and head are 10½ and the tail 10½ inches. It is therefore a large species not like yours."

174 Cumberland Street,
March 1st, 1867.

"Dear Sir,—

Yours of 27th ulto. was received this evening after my return from the daily conchological exercises at Dr. Cox's. So, as in my solitude—the reason for which I originally chose (when last in Sydney)—and now again have engaged this *attic* retreat with its windows, which I can keep open at night and sleep without danger of aggravating my dyspnoea—I feel quietly inclined, I answer your note at once.

In the first place, I cannot by any possibility leave Sydney in less than 2 months hence. My work with Dr. Cox will quite occupy that time, to do it thoroughly, and well; that is to say, conscientiously as well as my ability goes. And were it not for the delay about the plates, the result of which I cannot foresee, for the letter press of *Helix*, the first genus, cannot be put into the printer's hands until all the plates have been finished of that genus. I would be able, if the matter were placed in the hands of a proper printing firm—not that of the German Engel (Krefft's friend) to see the whole rapidly through the press and be ready for Cape York. Correcting as it passes through the press *must* be done by myself to ensure accuracy. I have thus explained so far my engagement with Dr. Cox, at least what I consider myself *morally* bound to do, and I shall do it, if the asthma doesn't choke me meanwhile, or one of the wild bulls of Bashan (or the county of Cumberland) stick his horns into my gizzard and bring my carcase before the Coroner.

When I go to Cape York it will not be for 2 or 3 months, but for *at least* one year and I hope two. By the beche de mer vessels which rendezvous there, I shall have opportunity of making trips to the islands in the Straits and elsewhere. I shall collect *everything except plants*.

My engagements are—those I mean by which I consider myself bound and which I shall strive to execute are—

1.—A *complete set of all insects* for Mr. McLeay to whom I am under obligations to that effect.

2.—A complete set of *shells* for Dr. Cox, for although I have not made any arrangement whatever with him to that effect, I feel in duty bound to let him have everything which I think he is likely to want, and knowing as I do, the extent of his collection, I believe I can do this very satisfactorily.

3.—I have to supply the Adelaide Museum with such birds as are mentioned in his list of desiderata.

I have no further engagement, for Mueller's offer about plants I have not accepted.

Therefore I am free to *engage with you* to supply you in the terms of your note with the nests and eggs which are desiderata to you, and you shall have *the first and best of everything* in that line. The skins of birds also will be attended to, but as you will understand from what I formerly stated, Adelaide gets the first *pair—you will get the second.* Nor do I know of one Cape York bird seen by me before of which I cannot to a certainty get more than 2 pairs as my visit will not be a flying one. For instance, if the first 2 *Microglossi* I shoot should be both males or both females, one goes to you. Among your birds you have left out *Tanysiptera Sylvia*—perhaps inadvertently. Some are Port Essington birds—as *Pitta Iris,* etc. These I cannot possibly get. You say nothing of *Sterna.* I can collect 1, 2 or 4 of each peculiar Cape York bird or rare northern species at 1/6 each. I would give in others—and tracheae as for instance the curious one of *Manucodia.* I shall, of course, be very glad when finished in Sydney and preparing for a start to receive an advance from you, but this can best be considered when the time comes. The outfit—for it will include means of living and collecting for 12 months during which I shall be entirely on my own resources—will be expensive, but what I shall have myself, and get from others, especially my brother, will suffice to furnish the means for collecting *efficiently.* I have put these things down *currente calamo,* but I shall explain matters better when I see you, which will probably be next week, on Saturday afternoon, if you are at home. If not some other Saturday will do. So I must now conclude this rambling letter and believe me to be yours truly."

Little did MacGillivray think when he jestingly wrote about the Coroner that the words should prove so fatally true in such a short time. On the 6th June MacGillivray collapsed and died from heart disease, though his asthmatic condition probably contributed to the fatal seizure. It is pleasing to note that the "Sydney Morning Herald" referred to him as the "distinguished naturalist".

The notebook fills in the pages from MacGillivray's leaving the service in 1855 until his death as follows:—

"June 28, 1856.—A few days before Anniversary Meeting of H.I.S. in School of Arts—Secretary then.

1858. Went to Port de France in February. September went to Eramanga Aneiteum.

1859. Tana, Eramanga and Aneiteum. September went to Eramanga in Cordelia, returned same year in Vivid. Windhover from Aneiteum to Eramanga.

1860. April went to Eramanga. Port de France in Bluebell. Julia Percy to Lizard Island.

1861. Torres Strait, etc. December returned to Sydney, via Rockhampton.

1862. In and about Sydney. A year lost.

1863. Went to Melbourne in March."

From the letters we find that he went to Grafton, or rather contracted with Wilcox on August 9, 1864, and remained two years. Returned to Sydney, worked for Dr. Cox for a few months and died on June 6, 1867.

The year 1862, of which he wrote "A Year Lost", is notable from his contributions to the Sydney papers of a series of articles dealing with his travels here. Twelve articles were printed in the "Sydney Morning Herald"

entitled "Wanderings in Tropical Australia", and others on Walkers Expedition, and Landsborough's Expedition.

In the first half of 1864 another series, at least nine in number, was written, "Scraps from Journals in the S.W. Pacific", published in the "Empire", Sydney. Probably others also appeared, but these are worthy of notice.

With regard to the "H.I.S.", of which he wrote in 1856, "Secretary then", this is not noted in the official Journal. This was "The Sydney Magazine of Science and Art", "containing by authority the proceedings of the Australian Horticultural and Agricultural Society and the Philosophical Society of New South Wales". The former was the successor of the H(orticultural) I(mprovement) S(ociety). In the first volume, dated June 15, 1857, there appears "a list of papers which have been read before these meetings (from May 15, 1855, to date)", and therein are included:—

"17. MacGillivray, on the Vegetable Productions of the South Sea Islands.
19. MacGillivray, on Sandalwood.
24. MacGillivray, on the Vegetable Productions of Cape York."

These were the titles only, but in Vol. ii., April, 1859, appears:—

"p. 196. Some Remarks on the Sandal Wood of the South Sea Islands. By John MacGillivray.

Among the tracts in the Australian Museum there is also "Hints on the Preservation of Specimens of Natural History. Intended for Country Residents. By John MacGillivray, F.R.G.S. Author of "Voyage of H.M.S. Rattlesnake", etc." This comprises nine pages, printed by the Government Printer, New South Wales, but is not dated.

During the stay of the "Rattlesnake" in Sydney, MacGillivray married a girl from Aberdeenshire, named Williamina Paton Gray. The marriage took place at St. Andrew's Scots Church on March 19th, 1848, the Rev. I. McGarvie, D.D., officiating. A daughter (Isabella) was born at George Street on Christmas Day the same year, and Mrs. MacGillivray and the child accompanied MacGillivray home on the "Rattlesnake", leaving Sydney April 28, 1850, and reaching England in October. Another daughter (Marion) was born at Crown Street, Aberdeen, in 1850, and a son, John, in London, in 1852.

Apparently, after MacGillivray left the "Herald" at Sydney, he sent for his wife and family, and there is written, "W. P. MacGillivray died" at sea off Van Diemen's Land on board 'Washington Irvine' from consumption."

There is no further note with regard to the children, who apparently came on to Sydney.

In this notebook is a complete account of the births and deaths of his brothers and sisters, very carefully compiled, probably the only authentic account of the elder MacGillivray's family. From this we find that there were only twelve children (not thirteen, as given in some places), that one died at the age of sixteen months, another at seven years, while a third died of consumption at the age of seventeen years. Before MacGillivray himself died, two of his sisters had also died of consumption at Ballarat. Victoria, to which they had come with Paul and others after the deaths of their parents. A sister, Anne Dorothea, apparently married the Rev. P. C. Beaton at Mauritius on the way out, and MacGillivray constantly corresponded with this brother-in-law, who wrote in "Good Words" in 1868 an article about MacGillivray, entitled, "A Martyr to Science".

It may be noted that before MacGillivray left on his first voyage he appeared in 1842 as Vice-President of the Cuvierian Nat. Hist. Society of Edinburgh, an extraordinary honour for one of twenty years of age.

The following list seems to cover his published scientific writings:—

1841. Notes on the Zoology of the Outer Hebrides. Ann. Mag. Nat. Hist., Ser. i., Vol. viii., pp. 7-16, September.

1841. On some Mammalia, Birds, and Fishes lately observed in the neighbourhood of Aberdeen. Ann. Mag. Nat. Hist., Ser. i., Vol. viii., pp. 230-231, November.

1842. Catalogue of the Marine Zoophytes of the neighbourhood of Aberdeen. Ann. Mag. Nat. Hist., Ser. i., Vol. ix., pp. 462-469, August.

1842. Account of the island of St. Kilda, chiefly with reference to its natural history, from notes made during a visit in July, 1840. Edinb. New Phil. Journ., Vol. xxxii., pp. 47-70, 178-180.

1846. An Account of Raine's Islet, on the N.E. coast of New Holland. Zoologist (Vol. iv.), 1846, pp. 1473-1481, October.

1846. Ornithological Excursion to the North Coast of New Holland. Zoologist (Vol. iv.), 1846, pp. 1481-1484, October.

1846. Notes on Australian Natural History. Zoologist (Vol. iv.), 1846, pp. 1485-1491, October.

1846. Nidification of some Australian Birds (signed, John MacGillivray; Old Aberdeen, September 25th, 1846). Zoologist (Vol. iv.), 1846, p. 1546, December.

1848. Letters from J. MacGillivray, Esq., Naturalist to H.M. Surveying Ship Rattlesnake, Capt. Stanley, R.N. (Communicated by Professor Edward Forbes). Ann. Mag. Nat. Hist., Ser. 2, Vol. iii., pp. 21-32, July.

1850. A Brief Account of the Researches in Natural History of John MacGillivray, Esq. The Naturalist attached to H.M. Surveying Ship, 'the Rattlesnake, on the North Eastern Coasts of Australia, New Guinea, etc., by John Gould, with Tabular View of Occurrence of Procellaridae. Contr. to Ornith. (Jardine), Vol. ii., pp. 92-105.*

1851. Sketch of the Natural History of such portions of the Louisiade Archipelago and New Guinea, as were visited by H.M.S. Rattlesnake, June to September, 1849. Journ. Royal Geogr. Soc., Vol. xxi., pp. 15-17.

1851. Narrative of the Voyage of H.M.S. Rattlesnake, commanded by the late Captain Owen Stanley, R.N., F.R.S., etc., during the years 1846-50. Vol. i., pp. i.-xii., Map, pp. 1-402, 7 pls. and 15 text figs. Vol. ii., pp. i.-vi., Map, pp. 1-395, 5 pls. and 2 text figs.

1852. Excursion to Botany Bay, New South Wales (dated January). Zoologist (Vol. x), 1852, pp. 3383-3386, March.

1852. Subterranean Colony of Freshwater Mollusks (dated March). Zoologist (Vol. x), 1852, p. 3430, April.

1852. Visit to Teneriffe, and Ascent of the Peak of Teyde (dated London, April). Zoologist (Vol. x), 1852, pp. 3441-49, May.

1852. Mangrove Swamps and their Inhabitants (dated March). Zoologist (Vol. x), 1852, pp. 3451-52, May.

1854. [South Pacific Botany]. Hooker's Journ. Botany, Vol. vi., 1854, pp. 353-363.

*Although title page and plates are dated 1852, this was issued in middle of December, 1851.

1858. Description of a new species of Grass Finch from New Caledonia. Ann. Mag. Nat. Hist., Ser. 3, Vol. ii., pp. 263-264, October. (*Poephila paddoni*).

1860. On the Habit of Notopteris Macdonaldii, Gray. Ann. Mag. Nat. Hist., Ser. 3, Vol. vi., p. 152, August.

1860. Zoological notes from Aneiteum, New Hebrides. Zoologist (Vol. xviii), 1860, pp. 7133-7142.

Whatever may have been MacGillivray's faults, all conchologists owe a deep debt of gratitude to him for the foundation of the study of the land shells of Australia. He had collected meticulously, and upon his leaving the service in Sydney he collected in the South Seas, and in 1861 went to Torres Straits, and upon his return Dr. J. C. Cox engaged him to arrange his collection. This was done, and a small Catalogue was issued by Cox in 1864. It was an unpretentious effort, but workmanlike, and some new species were included in it. After his expedition to the Northern Rivers, of which the preceding letters give some idea, MacGillivray was again engaged by Cox, this time upon an ambitious Monograph, and we have read MacGillivray's own idea of his responsibility. After MacGillivray's death the work was duly published, and is a work of reference to this day. It is so unlike any of Cox's later work that it was obvious to the student that Cox alone had not prepared it. In the notebook above referred to are notes dealing with the difficulties met with by MacGillivray in classifying Cox's new species. The elder MacGillivray wrote his own obituary notice, beginning, "I have been honest and sincere in my endeavour to promote the truth", and I would, notwithstanding anything, affirm that dictum as applicable to John also.

BREEDING HABITS OF A FEMALE OCTOPUS.

A. S. le Souef, C.M.Z.S. (Curator, Taronga Park Zoological Gardens), and Joyce Allan (Assistant Conchologist, Australian Museum).

Throughout the year the octopods in the aquarium at Taronga Park Zoological Gardens, Sydney, are a great public attraction. Recently, a female one, not only laid, but succeeded in hatching out a large batch of eggs, thereby enabling some interesting data concerning her and the young to be obtained. In an article written a few years ago(1), the authors noted some of the characteristics of a large female octopus, *Octopus cyaneus*, then breeding in captivity in the aquarium, but the eggs, though she guarded them carefully for many weeks, unfortunately did not hatch. Therefore, a few additional notes on the breeding habits of these remarkable animals may prove of interest to readers.

The octopus in question, though as large as the previous one, appears to be a different species. It may be mentioned here that the octopods of Australia have been investigated very little, and, although at least six species are recorded from New South Wales, the two most commonly found are *Octopus cyaneus* and the little rock pool form, *O. pictus*. It is not intended, however, to enter into the specific relationship of the different forms here, as the present article concerns only the breeding habits of one species, which may on further anatomical investigation, be (or not) a different species of *cyaneus*.

General appearance.—The animal had a large body, at least eight inches in length, which was very swollen and smooth, except for some large flaps noticed on it during the early part of its stay in the aquarium; these, however, gradually diminished, except round towards the underside, where they were visible when the body relaxed. There were also small spines round the large prominent eyes and head. The web was very wide and expansive, the arms quite two feet in length, free for a great part of their length, and armed with a double row of large, very strong suckers. The suckers were typically cup-shaped, the largest being from three-quarters of an inch to one inch in diameter, but diminished in size, both towards the mouth and towards the tip of the arms. The general body colour was greenish, covered with scattered black specks, the arms pale green, rayed with black-brown, and between the eyes were patches of brown. The most conspicuous colouring, however, was that of the suckers, which were rich brownish-red, very like the now popular colour London Tan, on the outside, contrasting markedly with the dead white of the inside of the cups. These looked very handsome against the pale green of the arms. The animal displayed the usual tendency to intensify its colours when disturbed or if its background was changed.

Habits.—One of us (le Souef) was able to make many observations during the day which were of great assistance in the writing of this article. The characteristics which he noticed were also witnessed by Mr. C. Camp and other members of the Aquarium staff, to whom our thanks are due. The octopus was caught in Sydney Harbour about the middle of September, 1936, and was placed in a tank about 6 x 4 feet, the water in

(1) Le Souef and Allan, Austr. Zool., vii., pt. 5, 1933, p. 373, pl. 20.

which is pumped direct from the harbour and is changed about three times in twenty-four hours. It is also aerated by compressed air, and was particularly pure at that time.

The cluster of eggs was first noticed on October 5th, but may have been extruded a few days earlier. It was placed on the underside of a flat rock which was raised a few inches from the bottom of the tank, showing how the octopus is able to compress itself into the narrowest crevice when necessary. The mass was cream coloured, about six inches across, and had the appearance of a heap of small sago grains. It consisted of hundreds of main stems about three to four inches long, of yellowish-green membrane, firmly attached to the rock by one end, allowing the rest to wave freely in the water. To each of these stems were attached numbers of the small creamy-white grain-like egg capsules. None of the capsules, each of which was attached to the stem by a very short thin stalk, appeared to have been at any time enclosed in the membrane, as had been noticed in the case of the former breeding octopus, *O. cyaneus*. The egg masses of the two were entirely different in appearance, the one consisting of hundreds of dark brown string-like strips of mucus, which enclosed the creamy capsules, the other a conspicuous mass of white grain-like capsules, only the stems of which were membraneous. Though in the case of the former female, the egg capsules eventually emerged from the membrane covering, in the latter and present case, they appear to have been free from the time of extrusion.

Though the eggs increased a little in size during development, the main change was an increasing transparency from opaqueness, and a corresponding change from creamy white to a pale bluish-green. The female took great care of the eggs, and never left them for a moment. She stretched out towards, and drove off, another occupant of the tank whenever it approached. The egg cluster was continually aerated by a current of water forced out from the siphon of the female, who also kept up a constant and uncanny movement with her tentacles, writhing them in and out amongst the eggs, lifting up the different stems, and keeping them constantly in movement. The amount of energy used up in this duty must have been tremendous, as the whole body acted like a pair of bellows, contracting and expanding about sixty times per minute. This activity increased as incubation continued, and became more intense as the eggs began to hatch. It was undoubtedly due to this excessive aeration that the eggs hatched, as in captivity they need constant movement, such as they get in their natural habitat, if they are to develop beyond an early embryonic stage.

Hatching took place from the 10th-15th November, between 5-6 weeks after the eggs were discovered. When the young were hatched, they made their way to the surface by rapid darts and jerky movements, each fresh jerk sending the individual about an inch ahead, and seen through the glass of the tank, to the naked eye, they looked like hundreds of little water fleas. Each time the mother aerated the egg mass, or lifted it up with her arms, a fresh batch of embryos emerged and rose to the surface, making about three pulsating jerks to the second. They did not survive for many days in captivity, but many may have escaped down the clearing out pipe into the harbour.

A close inspection of eggs, which had not discharged their embryo, revealed that each was oblong, balloon shaped, three millimetres long and

one wide, and, whereas in the early stages of development, a small pinkish black spot on each side of the otherwise milky opaque egg indicated the developing eyes of the embryo, in the later stages, through the clear transparent capsule could be easily distinguished the perfectly formed embryo. Ripple-like movements could be seen going along the embryo which filled the inside of the capsule easily, some time before it prepared to emerge. When it was ready to do so, a protuberance appeared at the end furthest from the attachment stalk, and by this protuberance breaking the young eventually emerged through a slit. All the time during the emerging process and for some time before, a remarkable play of colours, black, red, and brown in spots could be seen in the capsule whenever the embryo moved. In practically all cases witnessed, the embryo emerged tail first, taking about forty-four minutes to complete this process, which it did by active and constant jerky movements. The body appeared to emerge much quicker than the head portion with its accompanying arms.

When the young eventually broke free from its capsule, it was particularly noticed that if in a saucer of water at the time, the tiny creature showed even at that early stage in its life a remarkable power of changing its colours by means of chromatophores. When lying on the bottom of the saucer, which it did for a few seconds when it first emerged from the capsule, it adopted the pure white colour of the saucer, but when by a series of puffs and jerks it arose towards the surface of the water, the colour changed to more natural ones. The little octopod differed only in its delicacy from mature ones. Though only about three to four millimetres in length, its body was perfectly shaped, the arms, at first very short with a fine filament at the end of each, showed small suckers, and the conspicuous very dark eyes often exhibited a red and blue opalescent tint. When most energetic, the usual small black and red spots on the dorsal surface of the body and arms became intensified, and in the case of the former, changed or were replaced by very large red-brown patches, arranged in a definite pattern. This pattern was most marked against the silvery blue-white general body colour, and was absent from the undersurface, which contained only the smaller red and black spots.

The few days preceeding the hatching of the eggs, and the days on which they emerged were particularly warm ones, and possibly this had some influence on the eggs. It was noticeable that when one embryo commenced actively moving in a capsule it seemed to give a similar impetus to the others. Viewed under a microscope the young were such delicate, really beautiful little creatures, fascinating in their movements and colour changes, that it is difficult to imagine them growing into the ferocious looking adult octopod.

The outstanding point of interest in the behaviour of the female was the strong maternal instinct which she displayed. Both she and the eggs were twice transferred to a smaller tank in the sunlight for photographic purposes and later returned to the original position. This handling did not in the least disturb her equanimity as the instinct seemed to dominate all other reactions. The aeration movement, the taking in of water and letting it out through the siphon, is a constant and normal condition, which is carried on irrespective of whether the animal is guarding her eggs or not, and is therefore continued until the parent herself dies.

Though the female, who throughout the hatching of her young refused any kind of food whatever, maintained her strength and healthy ap-

pearance long enough to enable her to perform this duty, she died soon after the young had dispersed. On examination her ovary was found to contain a number of small eggs. The idea is prevalent amongst some people that unless her eggs hatch, the parent is doomed to die. This is quite erroneous, although through the female refusing food for so many weeks, she is naturally weakened and is quite likely to pass away after her work is finished, a fact which may have given rise to this belief. It is generally understood that her death is a natural event following the laying of so many eggs. In the course of events, if an animal which laid so many thousands of eggs at one time, survived too long, the sea would become over-populated with the offspring of the parent, to the great disadvantage of other animals.

Whilst preparing this article, a report(2) of the Marine Fish Hatchery and Biological Station, at Portobello, Dunedin, New Zealand, has come our way. In this mention is made of the breeding habits of the large New Zealand Octopus, *Octopus maorum,* which laid and hatched her eggs in captivity at the hatchery. The eggs are described as tiny Indian club-shaped, and attached in pairs to the glass of the tank. Apparently the various species of octopods lay different types of eggs, as we have already two different kinds amongst the larger Sydney species, and a record now of a New Zealand species producing yet another type.

(2) New Zealand, Report on Fisheries, Marine Dept., year ended 31st March, 1936, p. 22.

EXPLANATION OF PLATES.

Plate VI.

Photograph of *Octopus* sp. sitting over her eggs and aerating them by currents of water forced out through a fleshy siphon and by constant writhing movements of her tentacles. Photograph, J. N. Boberg.

Plate VII.

Fig. 1. Portion of egg cluster showing capsules with developing embryos.
Figs. 2-3. Front and side view of young octopods.
Fig. 4. Side view of young just after hatching.
Fig. 5. Large tan-coloured chromatophores on the head and between the eyes are shaped thus when the young octopods are disturbed.
Fig. 6. General design adopted by tan-coloured chromatophores on dorsal surface. The position and shape of these are always constant. They are absent from the under surface.
Figs. 7-8. Octopod emerging from an egg capsule, tail first; this is the more usual manner of escape.
Fig. 9. The split in the distal end of the capsule after the embryo has emerged.
Fig. 10. A rare occurrence amongst the eggs examined. A young embryo which emerged head first from its capsule.

OBSERVATIONS ON THE KOALA IN CAPTIVITY.

SUCCESSFUL BREEDING IN MELBOURNE ZOO.

By David Fleay, B.Sc., Dip.Ed.,
Former Curator, Australian Section.

(Plates viii.-xi.)

Begun in March, 1934, the year of Melbourne's Centenary Celebrations, in the planning and construction of a Native Fauna Section in the Zoological Gardens, a central place of honour was relegated to our most affectionately regarded and lovable Koala.

The octagonal paddock, sixty feet in diameter, was furnished with four dead trees, more or less regularly spaced and transferred from another part of the gardens. The largest of these was built over by means of the provision of a bark house sixteen feet in height. This afforded complete protection from prevailing cold winds, while in its interior additional resting places for the Koalas were added by the simple expedient of nailing extra forked branches to the limbs of the shelter tree. Though only two or three Koalas were present in the early stages of this new grouping of Australian animals, the number gradually increased as Koalas confiscated from illegal captivity by the Fisheries and Game Department were added. Early in 1935 there were ten Koalas in the paddock, including a small light-grey and very shorn-looking Queenslander.

This solitary member of the northern sub-species (*Phascolarctos cinereus adustus* Thomas) came as a juvenile among the earlier arrivals in 1934. He travelled from Queensland by car and was then left at the Zoo by owners who were either worried at the problem of maintaining its eucalypt diet, or who experienced qualms at the probable consequences of illegal possession. At all events, they did us a favour, for this Queenslander has been, and still is, one of the outstanding marsupials in the collection. For several months during his infancy, this shorn-looking little Koala, with his curious absence of tufted ear fringes, was foster-mothered by a furry Victorian Koala, which arrived at that time with a similar sized young one of her own.

The food for the Koalas was provided daily in the main fork of the shelter tree, where the eucalypt branches were kept fresh, with their butts fastened in camouflaged tins of water. At this time, as for some years previously, the main food gum supplied to the animals consisted of the stunted rough-barked manna gum (*E. viminalis*) growing on the coastal Tertiary sand areas south-easterly from Melbourne and delivered to the Victoria Market several times weekly by a market gardener who, unfortunately, was not entirely consistent in the quality of leaves supplied.

We now found that the Koalas showed a most decided taste for Long-leaf Box (*E. elaeophora*) which was supplied from the Ringwood area as the main food for the Greater Gliding Possums (*Petauroides volans*). Long-leaf Box is a eucalypt of comparatively low oil content, growing over a wide area in the south, north-east and east of the State, and as a continually acceptable favourite with our Victorian arboreal herbivorous marsupials generally, it has no equal. The Koalas also appreciated, though to a much lesser degree, helpings of the Common Peppermint (*E. australiana*) which is also a favourite food of the large Gliding Possums and Ringtails, and which it is interesting to remark has the highest percentage yield of oil

of any eucalypt.* The Possums and the large Gliding Possums (*Petauroides*) also share the taste of the Koala in the case of Manna Gum, and both the Red Gums, River and Forest (*E. rostrata* and *E. tereticornis*) were used as additional food under the shelter tree, but as the leaves were then taken from trees growing in the grounds, the bears received them only at occasional intervals.

On this system of feeding our Koalas were thriving and offering a most pleasing spectacle with their magnificent coats, bright eyes and healthy appetites. Two very large old males were the dominant figures of the group with an acute dislike for one another, particularly during the mating months of January and February. Occasionally they came to grips, cuffing and scratching out fur with their big claws, and biting one another, uttering squealing grunts the while. Usually, however, especially after a scuffle, vocal competition was the order of the day, with the two males at the topmost points of separate trees, chins in the air, uttering their rasping braying calls with the typical sharp and very audible inhaling, followed by guttural wheezing rumbles.

On the 8th of March, 1935, a young one appeared in the pouch of an exceptionally pretty female Koala, and a second female produced a young one during the first days of May.

However, coinciding with the coming of June, with its chill frosty weather, the Koalas became typically sluggish and inactive. Their appetites fell off considerably, and, though they still ate tips of long-leaf box and forest red gum, the manna gum appeared to be distasteful; where previously it had been eaten right down to the stalks it was now scarcely touched. However, considering the number of Koalas and the fact that manna gum was the only food present in sufficient quantity, it meant that even though their lessened appetites were easily satisfied during this cold period they had a restricted choice and were forced to make the best of it. Though the market gardener was sending in mature branch and extremities these were now very coarse with practically no finer tips.

At all events, much to our disappointment and sorrow, Koala after Koala, even the mothers with young in pouch, developed diarrhoea, and after some days of illness descended in a pathetic manner to the ground—there to die. In spite of frantic car trips in search of swamp gum (*E. ovata*) and the very best of the usual acceptable species, it was too late, and by the 8th July, 1935, our wonderful show of Koalas was reduced to the one little Queenslander. Though curled up in a dormant condition in his favourite fork and feeding very lightly and infrequently, this light-grey little fellow remained perfectly healthy. It was observed that when he did eat he favoured the Long-leaf Box, though still eating some *viminalis*.

Post-mortems held on the dead Koalas by Dr. Albiston, Director of the Veterinary Research Institute, and by Mr. H. Kendall revealed nothing of a definite nature, except, perhaps, an inability on the part of the animals to digest their usual food.

In reference to these diarrhetic symptoms displayed so often by Koalas *in extremis*, it is interesting to recall the experiences of Mr. J. P. Rogers, of Narre Warren North, an old collector and associate of Oldfield Thomas, A. J. Campbell and Gregory Mathews. Mr. Rogers spent his boyhood along

---

*Baker & Smith, "A Research on the Eucalypts and Their Essential Oils".

the Goulburn River, near Tallarook, and he remembers the time when 150 or more Koalas could be counted in the Red Gums (*E. rostrata*) in a walk of two miles along the river. In 1888 or 1889, however, these animals died out suddenly and completely. They were afflicted with severe diarrhoea and descended the trees to die on the ground in a pitifully poor and weak condition. Whether the season was winter or summer, Mr. Rogers does not remember, but he does recollect the shameful practice of shooting Koalas in South Gippsland and using the carcases as food for pigs!

Following the tragedy of the 1935 winter at the Zoo, no more Koalas were brought in until the summer of that year. Then, coinciding with the addition of thirty Koalas to the Badger Creek Sanctuary at Healesville, a new system of alternating the Zoo Koalas was adopted. Two or three at a time were to be sent down from Healesville and domiciled in the Zoo for a month or six weeks before being returned and replaced by others.

It was thought that by this means the animals would not be sufficiently long away from their natural haunts for dietary troubles to affect them.

However, the new system proved unsatisfactory. It takes a long time for adult Koalas to adapt themselves to restricted conditions. Some did not do so at all. On top of these difficulties the male Queensland Koala attacked any other male introduced to what he now considered to be his own particular territory, and he usually terrorised the stranger until it was sufficiently frightened to jump the protective strip of galvanized iron round the inside of the fence and so escape.

With the coming of May, 1936, the last of our visiting Koalas was returned to Healesville, and during the difficult months of June and July the Queensland Koala once more lived in solitary state.

As one may observe in the case of Victorian Koalas in the free state at the same period of the year, he again became dormant and sluggish in the cold weather. Even knocking and tapping on the tree trunk sometimes failed to arouse him from the typical tucked-in attitude of sleep, with chin folded in to his abdomen, ears drooping forward and head cuddled in his folded arms.

We were most careful constantly to provide him with a variety of eucalypts, consisting of the terminal branchlets and succulent tips from mature trees. It was very evident that again in June and July he was far more fastidious than usual about his food, and, lacking the thick furry coat of our southern Koalas, he displayed unusual sagacity for his kind in snuggling right down in the midst of the bunches of eucalypt leaves and remaining there each night in an advantageous position, both from the point of view of warmth and food.

On September 22, 1936, there arrived at the Zoo a young and rather sickly Koala, which had been rescued from unauthorised ownership by the Fisheries and Game Department. Thus we had a pair of the animals, the male being a typical specimen of the northern sub-species and the other a furry, fluffy-eared, and much prettier Victorian female.

From this time on it was apparent that it would be of greater value for future guidance to study the needs of these two in detail and solve perhaps the problem of keeping them in health throughout the year. Climate, food-trees, and Victorian bears presented a different case from that of either Koala Park or Taronga Park, N.S.W., or of Lone Pine Sanctuary, Queensland.

During January and February, the mating months of this year (1937), the male Koala was most vociferous, braying in characteristic Koala

fashion, nodding time with a lift of the chin to his quick and audible inhaling, and then with nose in the air performing the guttural rumbling exhaling.

An occasion of interest and rejoicing was the discovery of a newly-born young in the pouch of the female during the first days of March. The mother had developed into a splendid specimen, and, whereas previously she rarely took any notice of a gentle investigation of her pouch she now objected strenuously to such a procedure, and even attempted to bite one's hand or to reach out and scratch with her strongly clawed arms. Similarly, she resented the proximity of the male by uttering open-mouted grunts of protest. Towards the end of April, with the advent of cold weather and some rain, the two adult Koalas became less active and typically sluggish, spending the whole day curled up in the one position. Frequently, in the early morning, the female would be discovered balled up, with ears forward and down, in the upper forks of an exposed tree, apparently oblivious of the piercing cold and of the pouring rain dripping off her fur. Even smart rapping on the tree-trunk often failed to disturb her slumber. When she did awake, usually towards nightfall, with a characteristic upstretching of her head, and came across to feed in the shelter tree, it was evident for the first time that there were decided movements in the pouch wall, indicating that at nearly two months of age the hairless mite within was growing and becoming more active.

On May 20th it was noticed that the Koalas had begun to display their capricious tastes for the first time in the 1937 winter. They had practically ignored the *E. viminalis,* and as the days went by they lost appetite for it almost completely. It must be admitted that this *viminalis* did not possess the very choicest of tender terminal growth, depending as we did on supplies being forwarded. However, it was of a mature leaf standard (not sucker), which at other times of the year was thoroughly eaten down. Immediately on our noting the beginning of this seasonal fastidiousness the Koalas were given every opportunity in the matter of a plentiful choice of food, and, in view of the tragic happenings in the corresponding period of 1935, their selective feeding from carefully picked mature branchlets and sapling tops of a number of species of eucalypts was very carefully noted. Throughout the previous months they had fed well and maintained excellent health on daily renewed supplies of the rough-barked coastal form of Manna Gum, Long-leaf Box, common Peppermint (*E. cinerea* var. *multiflora*), with occasional supplies of Forest Red Gum, Swamp Gum, Apple Box (*E. Stuartiana*) and River Red Gum. Now regular car trips were undertaken, first of all to the Werribee and Little Rivers, and later to the Craigieburn district for the purpose of gathering the choicest of tips of River Red Gum, which at that time was sprouting in very acceptable branch extremity growth. At the same time we sought the red-stemmed sapling crown growths of Long-leaf Box out towards Vermont not far from Ferntree Gully.

Both species were much appreciated by the Koalas, but by far the most popular was the Long-leaf Box collected from Broadford and Tallarook districts, 50 miles north of Melbourne. Here the mature trees themselves had a different habit from those growing between Melbourne and the Dandenongs. They were less coarse and finer leaved. The Koalas entertained no doubts about this form of *elaeophora* and on each occasion trimmed it down almost to the last leaf, even enjoying the stalks as well. Forest Red Gum was also supplied daily, together with Swamp Gum and Yellow Box

(*E. melliodora*). Most mornings in June disclosed much the same evidence. The Manna Gum was untouched or nibbled to an insignificant extent, the Long-leaf Box was well sampled, the Forest Red Gum had been appreciated to a slightly lesser degree, River Red Gum to a smaller extent still, while the Swamp Gum may or may not have been touched.

However, the idiosyncracies of the Koalas in the matter of variation of diet defy description, and the addition of fresh and unusually select branches of any favourite species (including Manna Gum) at this time would cause them to busy themselves on this at the expense of other food.

June, as all residents of Melbourne will remember, was a freezing month of unforgettable fogs and frosts, and on some bitter mornings it was obvious that the Koalas had remained dormant the night through, for no leaves had been eaten. In fact, they now remained dormant most of their time, with only brief intervals for feeding in the evenings, just as they do under similar conditions in the bush. The Queensland Koala again cuddled down in the midst of the gum leaves, being fairly warm and comfortable there in spite of his short covering of fur.

The Koalas continued to feed fairly well on River Red Gum, Long-leaf Box and Forest Red Gum, occasionally chewing and eating the bark off the limbs of the latter species. Swamp Gum was always present and occasionally it was trimmed down—a treatment regularly accorded small quantities of the common Peppermint.

Yellow Box was a particular favourite with the little Queenslander, and this animal frequently concentrated on the profuse clusters of buds, as bears often do, eating them off in numbers together with their stalks in preference to the leaves. In passing, it is interesting to note a fact that has also been commented on by Mr. Robert Eadie, Hon. Curator of the Sir Colin Mackenzie Sanctuary, Healesville. In any particular species Koalas favour certain individual trees far more than others. We know that it is advisable to return to favourite trees—Red Gums, Manna Gums, or Box trees, as the case may be, for more branches after observing the hearty way in which previous samples of the tender branchlets have been eaten down. The addition of branches of the Queensland Lemon-scented Gum (*E. citriodora*) with its strong citronellal odour, was surprising in that on quite a number of occasions the Koalas sparingly ate its leaves.

Naturally, during this vulnerable period of June and July, the Koalas had a continuous choice of at least six acceptable species, so that at no time were they forced to eat any species which did not appeal to them. In the presence of abundant leaf shoots of a number of eucalypt species it was obvious that they displayed a particularly discriminating taste, pulling branchlet after branchlet forward, discarding some and accepting others. They were most deliberate in scenting out acceptable leaves, and with the provision of a wide and suitable selection they refused to touch any food that was unpalatable or injurious to them.

Red Box (*E. polyanthemos*) was obtained on several occasions, and though eaten as a change of fare was soon disregarded.

Grey Box (*E. hemiphloia*) proved more popular, but was not relished to nearly the same extent as the shoots from mature Blue Gum trees (*E. globulus*).

Silver-leaf Stringybark, which grows in company with Long-leaf Box in such districts as East Burwood and Vermont, and which in its sapling form is readily confused with the latter species, was found to be quite a favourite when the lanceolate-leaf sapling tops were taken. In fact, it is an un-

ashamed admission that for some time we had been supplying both species together under the pardonable misapprehension that all the leaves were those of Long-leaf Box.

Though the Koalas no longer appreciated Manna Gum at this period as in the two preceding years, it was continually supplied each day, together with the other eucalypts.

On the night of June 4th, when the quality was better than usual, a very small amount was eaten. On June 18th some tips of the typical gully type of straight white-barked Manna Gum was supplied, and the bears ate it by way of a change, but after two days declined to touch it, even when supplied with perfectly fresh samples from the bush. In view of the animals' lack of appreciation of what is actually their favourite fodder tree throughout most of the year, a test of the coastal Manna Gum, which had been rejected by the Koalas, was conducted at this time by Associate Professor Young, of the Biochemistry School, University of Melbourne, and he found no evidence of any such poisonous principles as cyanogenetic glucosides or of saponins. With the exception of occasional insignificant nibblings the *viminalis* remained off the list until mid-July, when, having become less enthusiastic about River Red Gum among the other foods, the bears gradually returned to the Manna Gum and by degrees began to eat it as heartily as they had done previously. This coincided with a general increase to normal in the total amount eaten and with a casting off of the lethargic state so continuous in the earlier parts of winter.

This record is not meant to convey any idea that Koalas refuse Manna Gum in the wild state because of their behaviour here during the months of June and early July. Then they are more fastidious than ever in selecting the very finest and tastiest of growing points in all eucalypts eaten, and probably they vary their diet more than usual. These are points upon which observation at such a time of the year in the bush would be very instructive. That the bears are lethargic and dormant in the cold winter days of June in the bush I know, from personal observation, and from talks with Mr. Eadie at Badger Creek, but actually they do not leave the Manna Gums in captivity in Southern Victoria with reasonable care and, provided one is prepared to travel far and wide each week in search of quality rather than quantity, Koalas offer no difficulties throughout ten months of the year, but in June and July, when the cold weather finds them dormant and sluggish, there is little doubt that they feed less, become extremely fastidious and must be given a great deal more care.

During this year (1937) the tenderer leaves from the branch and crown extremities of at least twenty species of eucalypts have been supplied to our Melbourne Zoo Koalas—the majority on many occasions and at least seven constantly. The collection of suitable samples of branches in the case of some of the more lofty species has often presented difficulties, but falling back on the old technique of a service rifle firing filled explosive bullets has simplified these matters considerably. The clearest idea of what these species are and of the reactions of Koalas towards them are conveyed in the following table:—

Victorian eucalypts supplied to a pair of Koalas in captivity in Melbourne Zoo, with remarks on the degrees of popularity.

N.B.—None of these species has been supplied singly, but always in association with at least five other acceptable species.

Eucalypts.	Common Name.	Remarks.
E. viminalis (rough-barked coastal type of Tertiary sand areas).	Manna Gum.	Most acceptable fodder tree throughout the year, with the exception of six or seven weeks in mid-winter, when the Koalas' appetite is more than usually fastidious.
E. viminalis var. *multiflora*.	Manna Gum.	"
E. viminalis (straight tall gully type).	Manna Gum.	Tender branch extremities much appreciated, but Zoo Koalas prefer finer-leaved rough-barked form to which they are accustomed.
E. elaeophora.	Long-leaf Box.	Thoroughly and enjoyably eaten at all times of the year. Branchlets and buds, as well as leaves. The bears delight in the very succulent tips.
E. cinerea var. *multiflora*.	Silver-leaf Stringybark.	Crown growths of lanceolate leaves on saplings enjoyed, but not those of mature trees.
E. tereticornis.	Forest Red Gum.	Much the most popular of the two Red Gums. The Koalas never tire of this species.
E. globulus.	Blue Gum.	Koalas keen on Blue Gum as a variation. Leaves are coarse and Koalas search for terminal shoots.
E. australiana.	Common Peppermint.	Eaten sparingly, but enjoyably throughout the year.
E. rostrata.	River Red Gum.	A very acceptable tree, frequently eaten for weeks on end.
E. melliodora.	Yellow Box.	Eaten fairly well for several days at a time, but not consistently. Profuse bud clusters often eaten.
E. polyanthemos.	Red Box.	Taken very sparingly and seldom. Only a few leaves here and there.
E. hemiphloia.	Grey Box.	Eaten sparingly and only as variation.
E. rubida.	Candle-bark.	Enjoyed at odd intervals.
E. ovata.	Swamp Gum.	Eaten fairly well at times, but not consistently.

Eucalypts.	Common Name.	Remarks.
E. goniocalyx.	Mountain Grey Gum.	Only single helping brought in. Koalas ate tips fairly well.
E. Stuartiana.	Apple Box.	An acceptable change at intervals.
E. obliqua.	Messmate Stringybark.	Buds and finer leaves eaten occasionally.
E. macrorrhyncha.	Red Stringybark.	Eaten sparingly. Not appreciated to a great extent.
E. capitellata.	Brown Stringybark.	Only finest tips nibbled. Disliked.
E. leucoxylon.	Yellow Gum, White Ironbark.	Distasteful.
E. botryoides.	Mahogany Gum.	Not liked, though growing points occasionally eaten.
E. cladocalyx (doubtfully Victorian).	Sugar Gum.	Distasteful and refused by Koalas, Possums and gliding Possums.
E. citriodora (Queensland).	Lemon-scented Gum.	Sparingly eaten occasionally.

According to the constituents of the essential oils investigated by Baker and Smith, these authors in their work divided the eucalypts into eight groups, and a brief consideration of several of these groups is interesting in linking up certain of the Koalas' food trees.

For instance, Group VI contains, among others—

E. viminalis,
E. rubida and *E. macrorrhyncha,*

all of which have a very low oil content, and in which group the oil yielded consists principally of pinene, cineol (eucalyptol) and phellandrene, but in which the cineol does not exceed 40 per cent.

Group V includes, among others—

E. tereticornis,
E. rostrata,
E. hemiphloia.

In this group the oil consists largely of cineol pinene and aromadendral, but in which the cineol again does not exceed 40 per cent. Phellandrene is usually absent.

Group IV contains two subdivisions:—

(a) *E. elaeophora,*
E. punctata (a N.S.W. favourite),

in which species and others like them an oil containing over forty per cent. of cineol is yielded, but in which pinene is diminishing and aromadendral making its appearance, "thus approaching the typical Boxes". Phellandrene is absent.

Subdivision (b) includes:—

E. melliodora, in which species there is an oil also yielding over 40 per cent. of cineol, but in which phellandrene is making its appearance, thus approaching the more pronounced phellandrene-bearing oils.

Group III is also subdivided to form two classes. In the second of these is found a number of species of high oil content, including:—

E. globulus,
E. goniocalyx,
and *E. australiana.*

The oil consists principally of cineol and pinene in which the cineol exceeds 55 per cent. Phellandrene and aromadendral are absent.

Group II includes *E. maculata*—
an acceptable New South Wales Koala tree.

Eucalypts of this group yield an oil consisting principally of pinene and cineol (not exceeding 40 per cent.). Phellandrene and aromadendral are absent.

Group I includes *E. botryoides,* which is disliked by Koalas. The oil of members of this group consists largely of pinene, without phellandrene and cineol is almost or quite absent.

Cineol is apparently a vital constituent for, in both Groups I and VIII, where it is almost or quite absent the leaves of several species experimented with are either very sparingly used or absolutely unacceptable.

The Development and Habits of the Young Koala.

The last mention of the young of Koala referred to its movements becoming noticeable in the pouch wall towards the close of April, 1937.

We did not care to risk a close investigation, but evidently the young animal, now two months of age, had developed sufficiently to be able to release or attach itself to the mamma at will. Towards the close of May, at three months of age, the baby formed quite a sagging bulge in the pouch when the mother moved down to feed, usually towards 5 o'clock in the evening. At three and a half months of age—in mid-June—a fine coating of hair began to appear on the baby Koala's body. Its bulk at the time of the growth of this light grey coat was about that of my closed fist, but not yet had it been observed to project any part of its anatomy from the pouch opening. Another curious fact was that the parent, like a mother Wombat and unlike Kangaroos and Possums and many other marsupials, had not been seen to hold her pouch open and cleanse it with her tongue, either by day or night. However, as we discovered later, the pouch was very clean and not filthy as in the case of a Wombat carrying a young one.

From this 3½ months stage onward the growth of the baby was much more rapid. Towards the end of June it was a common sight to observe its red-soled feet projecting from the pouch entrance as the mother perched in a fork folded in a big furry ball round the considerable bulge in her pouch.

On 28th June, at four months of age and before the young one had even been observed either to look out of the pouch or to venture forth of

its own accord, we took it out of the maternal shelter—a difficult matter, considering the non-elastic nature of its opening and the shrewd bitings and scratchings of the indignant mother. At this short-furred stage we found the baby to be a miniature replica of its shorn-looking Queensland father and a male.

Mr. F. Lewis (Chief Inspector of Fisheries and Game), Cinésound camera men and I took a series of pictures of the little fellow, who meanwhile uttered sharp grunting squeaks of mingled protest and appeal to his mother. The baby Koala was now clothed in crisp short grey fur, had beady black eyes, a prominent leathery nose and a ridiculously thin wispy fringe round each ear. The mother responded to the infant's sharp requests with deeper guttural grunts, and leaping through space from her tree several feet to a vertical post she backed down to the ground towards her offspring, relying more on auditory perception than on vision for direction in the sunlight. Eagerly she sought her precious charge, even threatening to climb one's legs towards the source of that anxious baby voice should her baby be further withheld from her.

From now on, having passed the age of four months, the young Koala became more venturesome and inquisitive. It was occasionally seen with head and one arm projecting from the pouch, and on 2nd July it was observed to leave the pouch and circumnavigate the mother completely before re-entering its nursery. On the afternoon of 3rd of July a most amazing habit of the juvenile Koala was revealed, strangely coincident with an interview which I had with Professor Wood-Jones at the University that morning. The Professor showed me a letter which he had just received from Sir Cedric Stanton Hicks, Professor of Physiology at the University of Adelaide, who stated that he had been to see a colour film taken by Mr. Keith Minchin, of Adelaide, in which a small Koala was depicted eating its mother's faeces, and Professor Wood-Jones' opinion or previous experience of such a curious matter was sought.

Professor Wood-Jones asked whether I had ever observed or heard of such an extraordinary and unattractive habit, and we were both agreed in dismissing the matter as degenerate behaviour on the part of the particular young Koala concerned.

Arriving at the Koalas' paddock at the Zoo about mid-day, I approached the shelter tree and was immediately struck by the curious attitude in which the mother Koala was posed in one of the forked branches. Her hind limbs were projecting upwards and outwards at a wide angle, while her head and shoulders were bent forward leaving the abdomen almost on a horizontal plane. The young one had its head and forelimbs out of the pouch, and was leaning forward deliberately working and stimulating the region on each side of the mother's cloaca with alternating grasping fore-paws. In response to this the mother ejected faeces from the rectum which the young one immediately began to devour. For over an hour this strange process continued; and the mother had long since ceased to produce the typical date-stone shaped droppings and now produced soft, shapeless, comparatively undigested faeces, apparently more suited to the young one's liking. Eventually satisfied, the young Koala retired again to the pouch.

This was most certainly the first time the young animal had performed this curious feat, for now the mother's whitish fur was stained and saliva covered from the licking of the young one for a radius of two inches about the cloacal region, and it remained in this state for at least half a day

following this event and others that followed. Added to this, an astonishing quantity of crumbled faeces lay on the ground beneath the Koala's position.

In the light of subsequent observation, it is obvious that this curious habit occurs during the transition period between the Koala's first days of emerging from the pouch, when four months old, and still strictly deriving its only sustenance from the mammary gland, and the time of becoming broken in to the adult diet of eucalypt leaves.

The habit of feeding on faeces, which in this case occurred only on ten irregularly spaced occasions over a period of three weeks, is dropped completely as soon as the juvenile begins to feed on the leaves. Naturally, however, the milk from the mammary gland remains as an additional source of sustenance for some time to come. A list of the dates showing intervals between the feeding on faeces sums up the period during which the young one gradually adapted itself to the gum-leaf diet of its more mature days. Naturally, unless one watches very closely, this habit is not a very obvious one, and in the case of our Melbourne Zoo young Koala it was witnessed only on five occasions. Each time the mother was observed to adopt an attitude to facilitate the needs of the young animals.

The following is a list of the dates on which the young Koala ate its mother's faeces:—

July, 1937, 3rd.—First observed. Fed for 1½ hours. Early afternoon.
„ 5th.—Had taken place again. Not observed, but traces seen about cloacal region of parent.
„ 6th.—Third occasion 4.30 p.m. Lasted at least 1½ hours.
„ 7th.—Cloacal region indicated a fourth occasion. Not witnessed.
„ 10th.—Fifth occasion. Not witnessed.
„ 11th.—Sixth occasion. Not witnessed.
„ 13th.—Seventh occasion. Witnessed and photographed 2 p.m. Duration 1½ hours.
„ 18th.—Eighth occasion. Not witnessed.
„ 19th.—Ninth occasion. Witnessed. Duration 1½ hours.
„ 26th.—Tenth occasion. Witnessed. Duration 2 hours.

On the 22nd July the juvenile, which now spent most of its time folded up in the mother's arms, cuddled in her lap, was seen for the first time to be pulling down leaves within its reach, and from this position tentatively nibbling at them. From this time on it made only one further attempt (July 26th) to feed on faeces extruded by the mother under stimulation; and it became more and more proficient at reaching out for tender leaves and chewing away in a slow but contented fashion. Until July 9th the young animal spent most of the day inside the pouch, emerging late in the afternoon, but after this date, with increasing bulk and fur growing longer, it spent more and more time cuddled in its mother's lap. However, cold windy days still found it occupying the pouch almost to bursting point, with red-soled feet sticking forth owing to the accommodation being taxed to the limit. The last time the young one was seen completely in the pouch was on 31st July, which coupled with previous dates indicates that until four months of age the juvenile is completely within the pouch; and for a further month it is able to slip in and out at will until, at the age of five months, it is no longer possible for it to take other shelter than that of the

mother's arms during the day time. The young one is very curious and often peers out from beneath the mother's arm to see what visitors are doing.

At the time of writing (midway through August) at five and a half months of age this young Koala is ten inches in combined head and body length. It is vigorous and strong and so keen of claw that one's hands suffer from the results of handling it. Now for a fortnight having left the shelter of the pouch completely, though still obtaining nourishment there, its coat has developed considerably. It still clings to its mother's underside when she climbs about during the day time, but after dark perches high up on her shoulders, as attractive a silhouette on a moonlight night as one could wish to see.

Though the young of many marsupials, including Wombats, Native Cats, Tiger Cats, Tasmanian Devils and Possums are very playful when young, it is a curious but scarcely surprising fact that this playtime period appears to be entirely lacking in the case of our stolid Koala.

The pelage of this young Koala in the Zoo now favours the dark grey colour of its mother; in fact, with its longer fur it is now a typical baby Victorian bear. But for the fact of seeing its quaint little Queensland father of the northern sub-species, and being told of its interesting parentage, one would not find anything unusual in its appearance. However, in view of its progenitors, its future development will be most interesting to follow.

Queensland Koalas in Other States.

For the past three weeks the Queensland father of the young Koala has been off colour and has lost some of his good condition. Associated with this indisposition he adopted the practice (usually a sign of fast approaching death in Victorian Koalas) of descending to the ground at least once each day and lapping slowly and clumsily from the water vessel for some minutes. However, his appetite is as healthy as ever it was, and, having already been more than three years in captivity, he evidently intends to continue his leisurely and apparently contented existence.

From the evidence at hand it appears that members of this northern sub-species are almost certainly more hardy and amenable to captive conditions than our own Koalas. The majority of those in Koala Park, those in Taronga Park, and Adelaide Koala Park are Queenslanders. So is the one living in Hobart, which came into prominence during the recent discussions anent the Duchess of Kent and her wish for a Native Bear. There is also the case of a Queensland Koala cited in a paper by A. S. Faulkner, and communicated by A. F. Basset Hull, in Vol. 3, Part 3, of the *Australian Zoologist*. Mr. Faulkner took his Koala as a juvenile in 1914 from Proserpine, North Queensland, and reared it on cow's milk, and what he described as blue gum leaves. He took it all the way to Albany, Western Australia, and at the time of writing (1923) had had it 8½ years, and it was in the most vigorous health. It still enjoyed ½ pint of cow's milk per day in addition to flood gum (*E. rostrata* ?) "York Gum" and "White Gum". It also frequently licked up gravel and earth (a habit never observed in the case of our Koalas in the Zoo, although it may have been indulged in at night) and greedily ate peppermint sweets!

At Lone Pine Zoo, where Koalas of extraordinary longevity are cared for by Mr. Reid, the animals flourish on a fair proportion of artificial food.

In view of the hardiness and adaptability of these Northern Koalas, it has struck me that with the possible creation of a number of small sanctuaries for Koalas in Victoria, it would be interesting to obtain from Queensland a male and several females of healthy stock and turn them out in a protected area in the Broadford, Tallarook or Trawool districts. Here, in the vicinity of the Goulburn in this warmer area, are magnificent River Red Gums, once inhabited by thousands of Koalas. At hand on the hillsides are Long-leaf Box trees, Yellow Box, Grey Box, Red Box, Red Stringybark, Blue Gums and other eucalypts. With protection and in the absence of fire—not so likely here as at Healesville, Marysville, or in other big timber areas, the Koalas should thrive, and, though not so pretty, they should prove as others have done a more hardy stock than our own Victorian animals.

EXPLANATION OF PLATES.

Plate VIII.—"Give me back my Baby". Young Koala shown five days after it had completely outgrown the pouch (aged five months).

Plate IX.—(Top): Progeny of a Queensland father and a Victorian mother, taken from the pouch on 28th June, 1937, at four months of age, before ever having emerged of its own accord. (Lower): Showing how tightly the young Koala can cling at that early age.

Plate X.—1.—Male Queensland Koala, remarkable for its shorn and naked appearance, its unfringed ears, light grey colour, and comparatively small size. It is the father of the young one shown in 2.

2.—This young one frequently rested in its mother's lap, folded in her arms, between the ages of four and five months. Having reached five months it had obviously outgrown the pouch and was not seen to enter it again. Photograph taken at 5½ months of age.

Plate XI.—(Top): Mother Koala launching herself across to a post in order to descend rapidly in response to her young one's cries. (Lower): Mother Koala attempting to recover her young one.

NOTE:—The eating of faeces above described suggests a valuable line for careful observation. The description of "crumbled faeces" and the subsequent extrusion of "soft, shapeless apparently undigested faeces" point to the process being of a similar nature to the regurgitation of semi-digested seeds in the case of pigeons, and fish in the case of gannets and pelicans. Regurgitation is also noted in the case of dogs when their puppies are nearing weaning time. A connection between this extrusion of semi-digested food and the extraordinary length of the vermiform appendix may be discovered as a result of more intensive observation.—Editor.

REVIEWS.

The Call of the Koala, by Ambrose Pratt, Melbourne, 1937. Robertson & Mullens. 6/-.

Koala, by Charles Barrett, Melbourne, 1937. Robertson & Mullens. 2/-.
The Koala Magazine, Sydney, October, 1937.

I.—Mr. Ambrose Pratt, President of the Royal Zoological and Acclimatization Society of Victoria, details in handy form all he knows about the Koala and its habits. He also quotes extensively from published articles, and gives much information which has been communicated to him by other investigators, either verbally or in writing. The work is notable for the abundant references to his authorities, and is copiously illustrated by portraits of adult and young Koalas in characteristic attitudes, and some of their food trees from photographs, most of which have appeared in other publications. The collection of facts and theories, couched in more or less technical language, may be useful to those who are engaged in the effort to preserve the Koala, either in captivity or in a state of freedom. The absence of any reference to records of artificial feeding is notable, and there is no suggestion that steps might usefully be taken in this direction. The gruesome result of death and disaster from the attempts to provide the Koalas in the Melbourne Zoo with natural food set out in Chapter V should surely have moved the President of that Institution to inquire into the possibility of employing more or less synthetic foods. A perusal of the account of Mr. Faulkner's successful rearing of a Koala and its survival in captivity for 16 years (this Journal, Vol. 3, p. 112 and Vol. 5, p. 332) could have given Mr. Pratt food for thought. Correspondence with Mr. Reed, of Lone Pine, Brisbane, Mr. St. John Robinson, of Townsville, Mr. J. E. Ward, of Balmain, all of whom have successfully fed Koalas on materials other than eucalyptus leaves, would have produced valuable suggestions. This line of experimentation, it appears to me, is the one way out of the difficulty experienced in supplying Koalas with sufficient nourishment in forms more easily accessible and regulated than the present eucalyptus foliage, which appears to be subject to so much variation in its nutritious values or toxic contents.

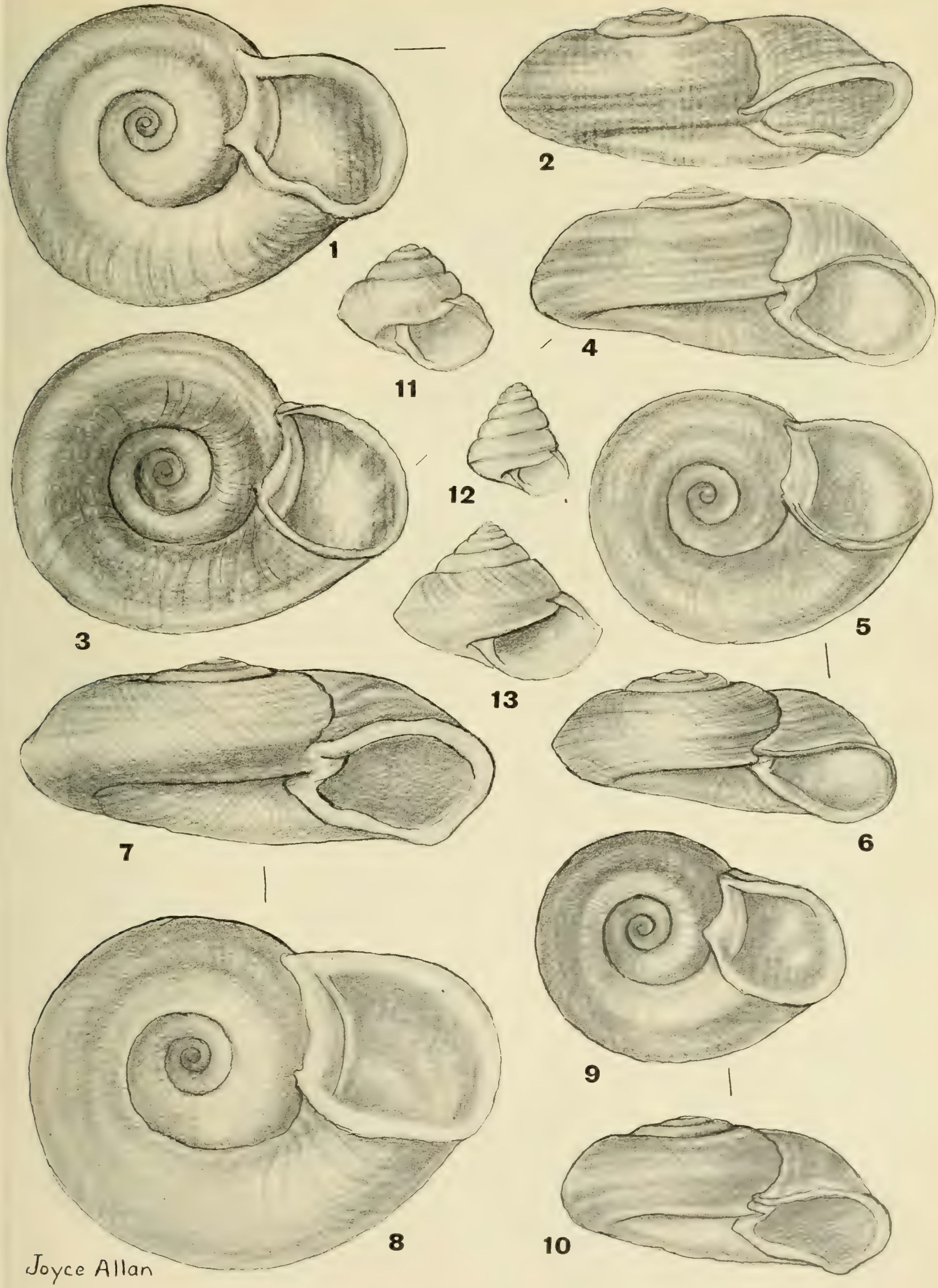
The value of Mr. Pratt's compilation of results of observations by others, as well as himself is seriously discounted by the puerile attempt to invest the Koala with human attributes and emotions contained in the second and third chapters. The stories (after Kipling, but a long way after) of Rudolph, Angelica and Edward might be suitable for children's bedtime, but in conjunction with the elaborately technical chapters composing the rest of the work, they are simply ridiculous. By the way, Mr. Pratt, the genus is more correctly referred to as Phascolarctus, not Phascolarctos. Another error is contained in the Introduction, where Mr. Pratt claims the Koala as the original of the "Teddy Bear" toy. Surely everyone knows that this toy originated in America, the Brown Bear being the animal copied, and Theodore Roosevelt, the noted big game hunter, being the Teddy after whom the toy was named.*

---

*See Chambers' 20th Century Dictionary (Supplement).

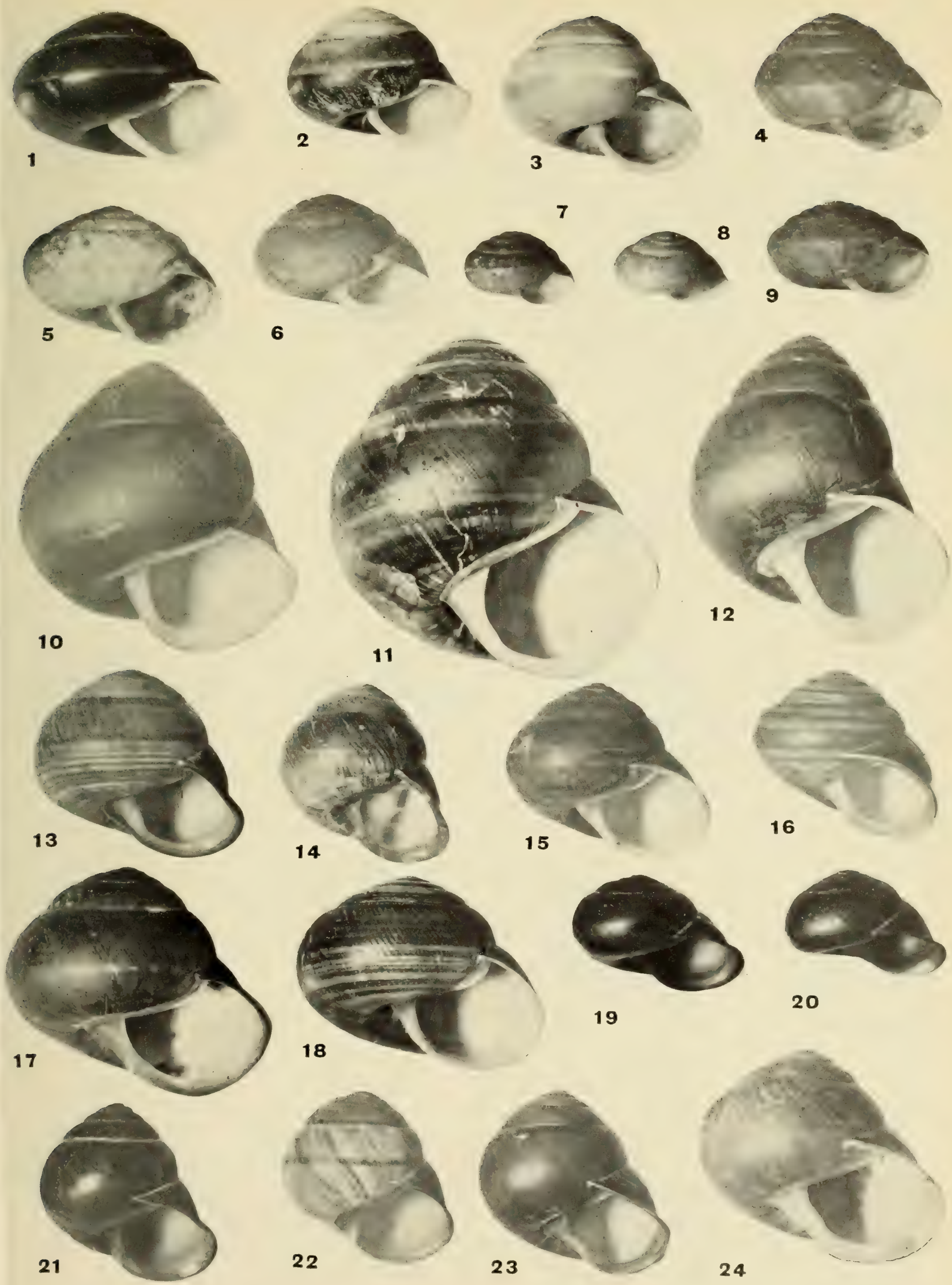
II.—Charles Barrett's "Koala" is a quite unpretentious, but none the less valuable contribution to the literature of Australia's marsupials. His account of the causes which led to the present belated attempt to preserve the Koala from extinction makes sorry reading. The wholesale destruction of the animal for the paltry gain of a few pence per skin, and the killing for the mere lust of slaughter, are both black marks on our past history. The efforts to preserve the species in public zoos and private gardens are sympathetically recounted, but, like Mr. Pratt, Mr. Barrett has no useful suggestions to offer as to experimenting with artificial foods. His illustrations are strikingly good, and his personal recollections of the early efforts to preserve the Koala make pleasant reading.

III.—Beautifully illustrated, both in colour and half tone, the journal of the Koala Club of Australia is a credit to its producers and printers. Designed to foster the efforts of Koala preservationists, and to incite wealthy citizens to contribute to the cause by becoming members (from 10/- to £25) this journal certainly is an attractive appeal. Special articles are not confined to the Koala, but include the Platypus, Australian Birds, and Wild Flowers. There are some doleful estimates of the remaining numbers of Koalas in the eastern States, and these are echoed by the previously reviewed publications. No reliable data can be supplied by the authors, and recent estimates obtained from disinterested observers in both New South Wales and Queensland suggest that these Jeremiahs could safely double or treble their estimates.



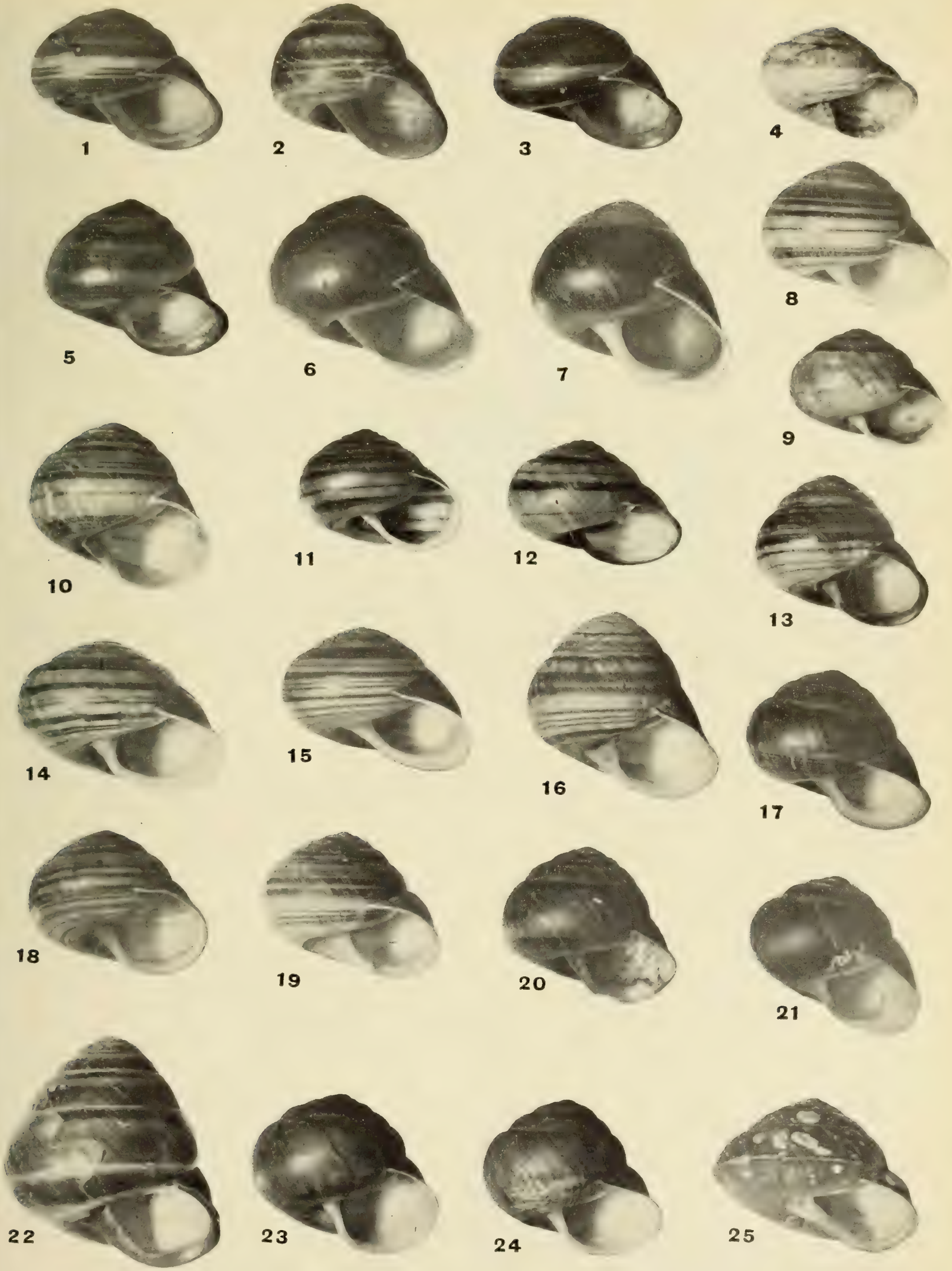
Australian Land Shells.

Joyce Allan. del.



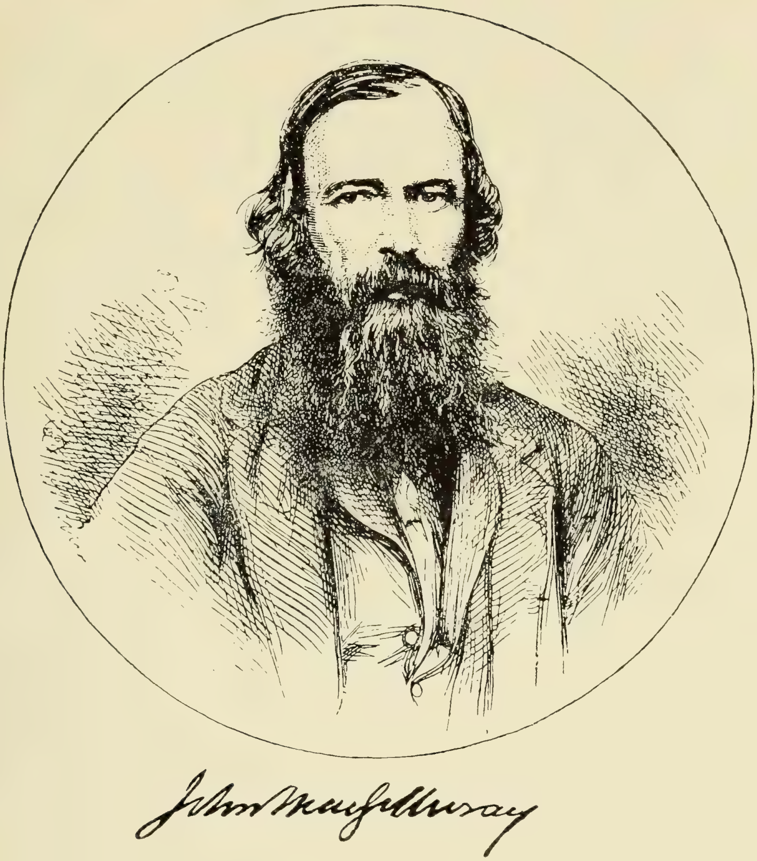
Australian Land Shells.

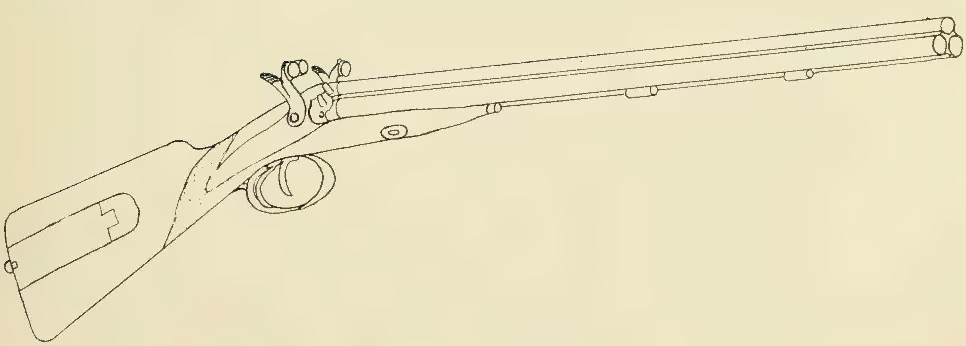
Photograph by G. C. Clutton.



AUSTRALIAN LAND SHELLS.

Photograph by G. C. Clutton.





MACGILLIVRAY'S FAMOUS THREE-BARRELLED GUN.

South Grafton July 28/65

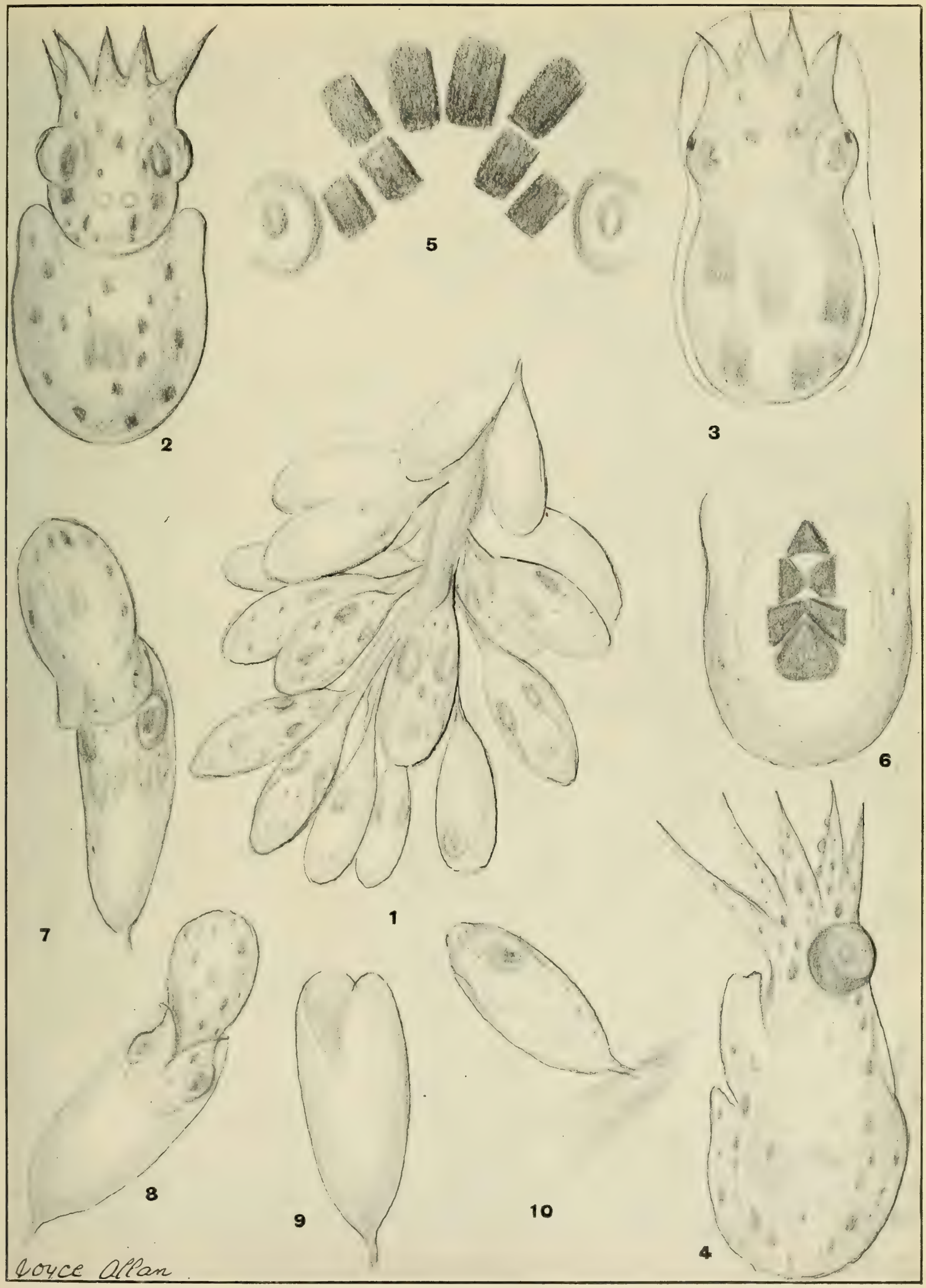
Dear Sir/

Yours of the 17th instant reached me in due time and as I am in the way of writing today, the steamer being overdue I may as well pen a few remarks as there will be a little parcel of skins for you. The two Australian species of Eurystopodus I have frequently started from the ground under bushes in various parts of the N.E. coast but never found the nest. Of Dacelo leachi, however, which you also mention, I got the eggs at Port Curtis, on Facing Island, opposite the settlement not then in existence. The nest was scooped out of an ants nest on a tree just as with our jackass here. The two fine Cape York Kingfishers - Tanysiptera Sylvia & Halcyon Torotoro (flavirostris of Gould) I found during my last visit to that place breeding in the large ant hills, the former abundantly, but of the latter I got only one egg. Of the long tailed one I have had a basketful brought me at once together with live specimens caught in the holes. Of Mycteria we have not got a skin. That of which you got the sternum was unfit for skinning, but the skull now forms part of the collection and

HOLOGRAPH LETTER OF JOHN MACGILLIVRAY.

OCTOPUS WITH EGGS

Photograph by J. N. Boberg.



OCTOPUS EGGS AND YOUNG.

Joyce Allan, del.

Young Koala shown five days after it had completely outgrown the pouch.
Photograph by S. Altson Pearl.

Cross between Queensland male and Victorian female Koala.

Photographs by David Fleay.

1. Male Queensland Koala.

2. Female Victorian Koala, nursing young one.

(Top). Female Koala launching herself across to a post in order to descend rapidly in response to its young one's cries. (Photographs by S. Altson Pearl.)

(Lower). Mother attempting to reclaim her young one. (Photograph by David Fleay.)

Royal Zoological Society of New South Wales.

Membership.

Class.	Amount of Subscription.
Associate Member	5 0 per annum.
Ordinary Member	£1 0 0 „

[Members joining after 1st January in any year pay one-half subscription.]

Life Associate Member	£2 10 0 in one sum.
Life Member	£10 0 0 „
Honorary Associate Member	No subscription. Elected for services to Australian Zoology or to the Society.
Honorary Member	

Titles.

(Conferred by the Council.)

Fellow	For distinguished services to Australian Zoology.
Associate Benefactor.	For contribution of £100 to the Society's Funds.
Benefactor	„ „ £500 „ „ „ „
Endowment Members	„ „ £1,000 „ „ „ „

Privileges.

Members of all classes may attend all meetings of the Society and its various Sections. Every member (other than an Associate or Life Associate member) receives a free pass to Taronga Zoological Park and Aquarium, and twenty tickets each year, admitting 20 adults or 40 children to the Park only.

Application for Membership

should be addressed to the Honorary Secretary, Box 2399 M.M., G.P.O., Sydney, accompanied by a remittance of the amount of subscription. The number of Ordinary Members is limited to 350, and should there be no vacancy at the time of application, the applicant will be registered as an Associate Member, and shall take precedence in accordance with the date of his admission to Associate membership.

PUBLICATIONS.

"The Australian Zoologist"

A Journal containing papers relating to the Zoology of Australia. Published at irregular intervals. Subscription to ordinary members elected prior to July 1, 1933, 1/- per annum; ordinary members elected after June 30, 1933, and all associate members, 2/6 per annum.

Vol. No.	Parts.	Date.	Pp.	Plates.	Price (unbound). £ s. d.
I.	8.	1914-20.	256.	19.	1 0 0
II.	4.	1921-22.	172.	45.	12 6
III.	8.	1922-25.	362.	41.	1 0 0
IV.	6.	1925-27.	362.	49.	1 0 0
V.	4.	1927-29.	362.	41.	1 0 0
VI.	4.	1929-31.	394.	32.	1 0 0
VII.	5.	1931-33.	398.	23.	1 0 0
VIII.	1.	1934-37.	346	19	1 0 0

Note:—Single parts of any volume may be obtained at published prices, less 20 per cent. to members or associates. Prices may be ascertained on application to the Honorary Secretary.

PUBLICATIONS (Continued).

Australian Zoological Handbooks.

Check-List of the Fishes and Fish-like Animals of New South Wales, by Allan R. McCulloch, Zoologist, Australian Museum, 3rd Edition, with additions by Gilbert P. Whitley. 108 pp., 43 plates. Price, 2/6. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

A Monograph of the Australian Loricates, by Tom Iredale and A. F. Basset Hull. 168 + xiii. pp., 21 plates and portrait. Price, 5/-. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

Bibliography of Australian Entomology, 1775-1930, by Anthony Musgrave, F.E.S. 380 + viii. pp. Price, 10/-. Postage: Australia, 6d. British Possessions, 9d. Foreign, 1/6.

Australian Spiders and Their Allies, by W. W. Froggatt, F.R.Z.S. Price, 2/6. Postage: Australia, 1d.; British Possessions, 2d.; Foreign, 3d.

CONTENTS OF THIS PART.

"THE AUSTRALIAN ZOOLOGIST."

Communications intended for "The Australian Zoologist" should be typewritten.

Authors should state whether proofs and reprints are desired when submitting MS. Fifty reprints of any article appearing under a separate title will be supplied gratis. If more are required, terms may be ascertained on application to the Editor.

THE AUSTRALIAN ZOOLOGIST

Issued by the
Royal Zoological Society of New South Wales

Edited by
A. F. BASSET HULL, M.B.E., F.R.Z.S.

Vol. 9—Part 2

Sydney, November 30, 1938.

(Price, 4/6)

All communications to be addressed to the Hon. Secretary,
Box 2399 M.M., General Post Office, Sydney.

Sydney:
The Sydney and Melbourne Publishing Co., Pty., Ltd., 29 Alberta St., Sydney.

London:
Wheldon & Wesley, Ltd., 2, 3, and 4 Arthur Street, New Oxford Street, W.C.2.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

Royal Zoological Society of New South Wales.

Established 1879.

REGISTERED UNDER THE COMPANIES ACT, 1899 (1917).

Patrons.

His Excellency the Governor of New South Wales,
The Lord Wakehurst, K.C.M.G.

Sir Philip Woolcott Game, G.B.E., K.C.B., D.S.O.

COUNCIL, 1938-1939.

President: Arthur Francis Basset Hull, M.B.E., F.R.Z.S.

***Vice-Presidents*:**

Neville William Cayley, F.R.Z.S., Garnet Halloran, B.Sc. M.D., F.R.A.C.S., F.R.C.S. (Ed.), Frank Marshall, C.M.G., D.D.S., and Theodore Cleveland Roughley, B.Sc., F.R.Z.S.

***Members*:**

Ernest John Bryce, F.R.G.S.
William Butler Gurney.
Aubrey Halloran, B.A., LL.B.
Keith Alfred Hindwood.
Charles Francis Laseron.
Albert Littlejohn.
Noel Lee Roberts.
Michael Stanley Reid Sharland.
John Ross Wallace.
Gilbert Percy Whitley, F.R.Z.S.

***Officers*:**

Honorary Secretary: Tom Iredale, F.R.Z.S.

Assistant Honorary Secretary: Miss Betty French.

Honorary Treasurer: Phillip Shipway.

Honorary Editor: Arthur Francis Basset Hull, M.B.E., F.R.Z.S.

Honorary Librarian: Albert Sherbourne Le Souef, C.M.Z.S.

Honorary Auditor: Robert John Stiffe, F.C.A. (Aust.).

OFFICERS OF SECTIONS (1938-39).

Avicultural Section.

Chairman: A. H. Brain.
Hon. Secretary: L. E. Deane.

Budgerigar Section.

Chairman: R. J. Murray.
Hon. Secretary: F. Brennan.

Marine Zoological Section.

Chairman: Miss Joyce K. Allan.
Hon. Secretary: Miss M. Golding.

Ornithological Section

Chairman: M. S. R. Sharland.
Hon. Secretary: Roy Cooper.

A BASIC LIST OF THE LAND MOLLUSCA OF AUSTRALIA—PART III.

By Tom Iredale.

(Plates xii.-xiii.)

Family Hadridae (continued).

The previous section dealt with the Queensland forms allotted to this family with the northern New South Wales (Oxleyan Sub-Area) species. The present series associated in the same family belongs to the Euronotian Faunula, a few small species penetrating northward into the south of the Solanderian Area and desertwards into the Larapintine Area. Under the name *Thersites jervisensis,* a medley of species has been confused, and the only way out is to reinstate the many species named by early workers. They were much nearer the truth than the lumpers of a generation ago, and it is certain scores of forms will be later recognised, the exact value of the forms being at present unknown. It is very definite, however, that the names here allowed represent recognisable units, and that the variation is easily limited. A study of the geology and botany of the country is necessary in order to understand the species here recorded.

Genus Meridolum Iredale, 1933.

1933. *Meridolum* Iredale, Rec. Austr. Mus., Vol. xix., p. 47, August 2. Orthotype, *Helix jervisensis* Quoy & Gaimard.

Meridolum jervisensis Quoy & Gaimard, 1832.

1832. *Helix jervisensis* Quoy & Gaimard, Voy. Astrol. Zool., Vol. ii., p. 126, pl. 10, figs. 18-21. Jervis Bay, New South Wales.
Mid New South Wales (coastal).

Meridolum corneovirens Pfeiffer, 1851.

1851. *Helix corneovirens* Pfeiffer, Zeitschr. für Malak., Vol. viii., p. 25, June. "San Nicolao", error = Mulgoa, New South Wales. Figd. Reeve, Conch. Icon., Vol. vii., pl. 194, sp. 1366, September, 1854.

1864. *Helix mabillei* Crosse, Journ. de Conch., Vol. xii., p. 285, July 1; id., Vol. xiv., p. 60, pl. i., fig. 6, January, 1866. "Oceanie" = New South Wales, fide Ancey, Journ. de Conch, Vol. lii., p. 295, December 25, 1904, from examination of type.

1868. *Helix mulgoae* Cox, Mon. Austr. Land Shells, p. 38, pl. i., figs. 3, 7, 7a, May. Mulgoa, near Penrith, New South Wales.
Mid New South Wales (Mulgoa district).

Meridolum morosum Morelet, 1853.

1853. *Helix morosa* Morelet, Journ. de Conch., Vol. iv., p. 369, pl. xi., fig. 15, November 1. Moreton Bay, East Australia.
South Queensland (coastal).

Meridolum gilberti Pfeiffer, 1846.

1846. *Helix gilberti* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 127, February, 1846. Darling Downs, N.S.W. (Gilbert) = Queensland.

1847. *Helix grayi* Pfeiffer, Mon. Helic. Viv., Vol. i., p. 134 (reviewed Zeitschr. für Malak., Yr. iv., p. 174, November, 1847), for *Helix* . . . . , Symb. Helic., pt. iii., p. 68, 1846, where Gray, New Zealand, pl. i., figs. 8-9, was cited, but this plate was never issued. East Australia. Figd. Syst. Conch. Cab. (Mart. & Chemn.), Bd. I., Abth. 12, *Helix,* pt. 2, p. 225, pl. 109, figs. 21-24, 1851 (Zeitschr. für Malak., Yr. viii., p. 104,

September, 1851, cites the plate from the Conch. Cab., but text at that date not issued) where "Coll. Gilbert" is added.

1929. *Hadra corneovirens* var. *ianthostoma* Cockerell, Journ. Conch., Vol. xvi., p. 321, July. Jennings, New South Wales.
South Queensland (inland). Northern New South Wales (inland).

MERIDOLUM EXPEDITIONIS Cox, 1868.

1868. *Helix expeditionis* Cox, Mon. Austr. Land Shells, p. 37, pl. xviii., fig. 12, May. Tropical Australia (Mitchell).
South Queensland (inland, north of preceding).

MERIDOLUM ASCENSUM *sp. nov.*

(Plate xii., fig. 1.)

This striking shell belongs to the *jervisensis-gilberti* series, but is very elevated with a height of 30 mm. to a breadth of 30 mm., all the other members being broader than high. The coloration is a greenish straw with a pale pink subsutural band, and a small reddish circumbilical patch. The columella is white, as the outer lip and inside of aperture, and strongly reflected entirely covering the umbilicus. The only sculpture is a fine even granulation throughout which continues on to the apical whorls. This lives on the lower Richmond River and all through that district.

Northern New South Wales (Lower Richmond River district).

MERIDOLUM EXOCARPI Cox, 1868.

1868. *Helix exocarpi* Cox, Mon. Austr. Land Shells, p. 44, pl. ii., fig. 2, May. Cherry Tree Hill, Mudgee, New South Wales.
New South Wales (Mudgee district).

MERIDOLUM DEPRESSUM Hedley, 1901.

(Plate xii., fig. 2.)

1901. *Thersites gulosa* var. *depressa* Hedley, Rec. Austr. Mus., Vol. iv., p. 22 March 29. Jenolan Caves, New South Wales (J. E. Wiburd).
Mid New South Wales (Jenolan Caves district).

MERIDOLUM GULOSUM Gould, 1846.

1846. *Helix gulosa* Gould, Proc. Boston Soc. Nat. Hist., Vol. ii., p. 165, August. New South Wales = Illawarra (Drayton). Figd. Gould, U.S. Expl. Exped., Shells, p. 65, pl. iii., fig. 43, 1862?

1847. *Helix coriaria* Pfeiffer, Zeitsch. für Malak., Vol. iv., p. 105, October. "Ceylon" = New South Wales, as above. Figd. Reeve, Conch. Icon., Vol. vii.. pl. lxxix., sp. 417, March, 1852. Copied, Pfeiffer, Syst. Conch. Cab., Bd. I., Abth. 12, pt. 2, p. 265, pl. 120, fig. 2, 1853.

1859. *Helix monacha* Pfeiffer, Proc. Zool. Soc. (Lond.), 1859, p. 25, pl. xliii., fig. 7 (January-February), Australia.

1864. *Helix scotti* Cox, Cat. Austr. Land Shells, p. 36. Mt. Keera, Wollongong, New South Wales (Mrs. Edward Forde). Figd. Cox Mon. Austr. Land Shells, p. 39, pl. x., figs. 4, 4a, May, 1868.

1864. *Helix cailleti* Crosse, Journ de Conch, Vol. xii., p. 285, July 1; id., Journ. de Conch., Vol. xiv., p. 59, pl. i., fig. 5, January 1866. "Oceania" = New South Wales, as above.
New South Wales (Illawarra Ranges).

MERIDOLUM MASTERSI Cox, 1864.

1864. *Helix mastersi* Cox, Cat. Austr. Land Shells, p. 19. Merimbula, New

South Wales. (Cox, Mon. Austr. Land Shells, p. 36, May, 1868, as synonym of *coriaria*).
New South Wales (Merimbula southwards).

MERIDOLUM DURALENSIS Cox, 1868.

1868. *Helix duralensis* Cox, Mon. Austr. Land Shells, p. 46, pl. viii., figs. 8, 8a, May. Dural, Wiseman's Ferry, Hawkesbury River, New South Wales.

In the same place nine pages earlier Cox introduced *laesa* Reeve for a shell from this locality, obviously the same species, but just as obviously not *Helix laesa* Reeve (Conch. Icon., Vol. vii., pl. 210, sp. 1490, December, 1854, which was described from unknown locality, and the figure does not appear to represent an Australian shell).

New South Wales (Wiseman's Ferry as above).

Genus GALADISTES *nov.*
Type, *Helix liverpoolensis* Brazier.

Small thin subglobose shells, spire small, mouth large, apex strongly granulose, sutures deep, outer lip of mouth thin, umbilicus almost closed by appression of reflection of columella; rudely radially sculptured, with a fine subordinate graining throughout, base smoother.

GALADISTES LIVERPOOLENSIS Brazier, 1872.
(Plate xii., fig. 4.)

1872. *Helix (Galaxias) liverpoolensis* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 618, November 3. Liverpool Range, N.S.W.
New South Wales (Liverpool Range district).

GALADISTES MARCESCENS Cox, 1868.

1868. *Helix marcescens* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 724, April 3, 1868. Mon. Austr. Land Shells, p. 37, pl. iv., fig. 5; pl. xviii., fig. 6, May, 1868. Clarence River, N.S.W. (J. MacGillivray).
New South Wales (Clarence River district).

GALADISTES ? PLICULOSA Pfeiffer, 1857.

1857. *Helix pliculosa* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856, p. 368, May 8, 1857. Drayton Range, North Australia (Stutchbury).
South Queensland (Drayton Range).

GALADISTES BOURKENSIS Smith, 1891.
(Plate xii., fig. 5.)

1891. *Helix (Hadra) bourkensis* Smith, Ann. Mag. Nat. Hist., Ser. vi., Vol. vii., p. 137, January 1. Bourke, Darling River, N.S.W.
New South Wales (Bourke district).

GALADISTES INTERVENENS *sp. nov.*
(Plate xii., fig. 8.)

A series of specimens collected by Mr. Sidney W. Jackson, about 40-50 miles north-west of Collarenebri, North New South Wales (inland), are thinner and smaller than *bourkensis* with the granulations a little coarser and the rude radials less marked. The umbilicus is practically closed by the reflected columella, and the outer lip is thin. The coloration is paler green, and the brown banding is weaker. Height, 13 mm.; breadth, 15 mm.

Northern New South Wales (Collarenebri).

Genus EXILIBADISTES Iredale, 1933.

1933. *Exilibadistes* Iredale, Rec. Austr. Mus., Vol. xix., p. 52, August 2. Orthotype, *Helix bednalli* Brazier = *sutilosa* Férussac.

EXILIBADISTES SUTILOSA Férussac, 1829.

1829. *Helix sutilosa* Férussac, Hist. Nat. Moll. Terr., livr. 29, pl. 17a, figs. 18-19, ex Tabl. Syst. Moll., p. 47, January; p. 43, June, 1821, *nom. nud.*; Vol. i., p. 203 (Deshayes), 1850. Ile St. Pierre & St. Francois, South Australia (Péron).

1872. *Helix bednalli* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 641, May 2, 1872. Near Adelaide, South Australia.
South Australia.

Genus CHLORITOBADISTES Iredale, 1933.

1933. *Chloritobadistes* Iredale, Rec. Austr. Mus., Vol. xix., p. 49, August 2. Orthotype, *Helix victoriae* Cox.

CHLORITOBADISTES VICTORIAE Cox, 1868.

1868. *Helix victoriae* Cox, Mon. Austr. Land Shells, p. 37, pl. xii., fig. 5, May. Western Port, Victoria (Masters).

1888. *Helix brunonia* Johnston, Papers Proc. Roy. Soc. Tasm., 1887, p. 75. King Island, Bass Strait. Figd. Petterd & Hedley, Rec. Austr. Mus., Vol. vii., p. 285, pl. 85, figs. 2-4 (type), August 30, 1909.
Victoria. King Is., Bass Strait.

This curious development of the *Meridolum* form, where a definite bristly covering is present without material differentiation of shell form, is certainly no relative of true *Chloritis* nor even to the family Chloritidae.

Genus VENTOPELITA Iredale, 1933.

1933. *Ventopelita* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Helix leucocheilus* Cox = *mariae* Cox.

VENTOPELITA MARIAE Cox, 1864.

1864. *Helix mariae* Cox, Cat. Austr. Land Shells, Add. p. No. 134. Clarence River, New South Wales (Macgillivray).

1868. *Helix leucocheilus* Cox, Mon. Austr. Land Shells, p. 54, pl. viii., figs. 7 a-b., May. New name for *H. mariae* only.
Northern New South Wales (Clarence River district).

VENTOPELITA BELLENGERENSIS Cox, 1871.

(Plate xii., fig. 7.)

1871. *Helix bellengerensis* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 54. Bellenger River, New South Wales.

1871. *Helix bellingenensis* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 321, August 16. Manarm Creek, Bellenger River, N.S.W.
Northern New South Wales (Bellenger River district).

Note.—At the present time the river is called *Bellenger,* but the town *Bellingen.*

VENTOPELITA LISMORENSIS Pilsbry, 1890.

1890. *Helix leucocheilus* var. *lismorensis* Pilsbry, Man. Conch. (Tryon), Ser. 2, Vol. vi., p. 140, pl. 40, fig. 13, December 16. Lismore, Richmond River.
Northern New South Wales (Richmond River district).

VENTOPELITA MANSUETA Reeve, 1854.

1854. *Helix mansueta* Reeve, Conch. Icon., Vol. vii., *Helix*, pl. 187, sp. 1304, July, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 57, January 10, 1855). Moreton Bay, Queensland (Strange).
South Queensland (Moreton Bay district).

VENTOPELITA YATALAENSIS Cox, 1873.

1873. *Helix yatalaensis* Cox, Proc. Zool. Soc. (Lond.), 1873, p. 149, pl. xvi., figs. 3a-b., June. Yatala Albert River, South Queensland.
South Queensland.

VENTOPELITA PUSILLA Hedley, 1912.

1912. *Planispira leucocheila* var. *pusilla* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 259, pl. vii., figs. 32-35, December 13. Tinaroo, S.W. of Cairns, North Queensland.
North Queensland.

VENTOPELITA CUMULUS Reeve, 1854.

1854. *Helix cumulus* Reeve, Conch. Icon., Vol. vii., pl. 195, sp. 1368, September. ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1854, p. 145, April 11, 1855). Banks of Manning River, East Australia.
Mid New South Wales.

Genus MERACOMELON Iredale, 1933.

1933. *Meracomelon* Iredale, Rec. Austr. Mus., Vol. xix., p. 52, August 2. Orthotype, *Helix rufofasciata* Brazier.

MERACOMELON RUFOFASCIATUM Brazier, 1875.

1875. *Helix* (*Hadra*) *rufofasciata* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 17, April 27. Yardea, 360 miles north of Adelaide, South Australia = Gawler Ranges.
South Australia (Gawler Ranges).

MERACOMELON SUBLORIOLIANUM Pilsbry, 1890.

1890. *Helix sublorioliana* Pilsbry, Man. Conch. (Tryon), Ser. 2, Vol. vi., p. 147, pl. 58, figs. 10-12, December 16. Flinders Range, South Australia.
South Australia (Flinders Range, east side).

MERACOMELON EXTENSUM Iredale, 1937.

1937. *Meracomelon subloriolianum extensum* Iredale, South Austr. Nat., Vol. xviii., p. 32, pl. i., fig. 7, September 30. Maldigo Hills, South Australia.
South Australia (Maldigo Hills). New South Wales (Silverton).

MERACOMELON LORIOLIANUM Crosse, 1863.

1863. *Helix lorioliana* Crosse, Journ. de Conch., Vol. xi. p. 273, pl. ix., fig. 6, July 1. Mountains behind Spencer Gulf, South Australia.
South Australia (Flinders' Range, west side).

MERACOMELON BROUGHAMI Angas, 1875.

1875. *Helix broughami* Angas, Proc. Zool. Soc. (Lond.), 1875, p. 389, pl. xlv., figs. 4-4a, October 1. Port Lincoln, South Australia.
South Australia (Port Lincoln district).

MERACOMELON CASSANDRA Pfeiffer, 1864.

1864. *Helix cassandra* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 527, April

20 1864. Murray Cliffs, South Australia. Figd. Cox, Mon. Austr. Land Shells, p. 50, pl. xix., fig. 8, May, 1868, from a painting of the type by Angas.
South Australia (Murray Cliffs).

MERACOMELON MOORUNDIANUM Iredale, 1937.

1937. *Meracomelon moorundianum* Iredale, South Austr. Nat., Vol. xviii., p. 32, pl. i., fig. 28, September 30. Tailem Bend, S.A.
South Australia (Tailem Bend district).

MERACOMELON STUTCHBURYI Pfeiffer, 1857.

1857. *Helix stutchburyi* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856 p. 386, May 8, 1857. "Drayton Range, North Australia (Stutchbury)," error = Port Elliott, South Australia. Cf. Angas, Proc. Zool. Soc. (Lond.), 1863, p. 520, April 20, 1864 (Figd. Cox, Mon., p. 39, pl. x., fig. 10, is not this species).
South Australia (Fleurieu Peninsula).

MERACOMELON MERIDIONALE Gude, 1903.

1903. *Thersites* (*Badistes*) *meridionalis* Gude Proc. Malac. Soc. (Lond.), Vol. v., p. 262, pl. vii., figs. 5-7, April. South Australia = Blinman eastwards.
South Australia.

MERACOMELON SUSPECTUM Iredale, 1937.

1937. *Meracomelon meridionale suspectum* Iredale, South Austr. Nat., Vol. xiii., p. 33, pl. i., fig. 27, September 30. Parachilna, South Australia.
South Australia (Flinders Range west).

MERACOMELON MARCIDUM Hedley, 1912.

1912. *Xanthomelon marcidum* Hedley, Rec. Austr. Mus., Vol. viii., p. 157, pl. xlv., figs. 47-50, May 6. Ualba Range 12 miles west of Lake Cudgellico, South Central New South Wales.
New South Wales (South Central).

Genus FINDOMELON Iredale, 1937.

1937. *Findomelon* Iredale, South Austr. Nat., Vol. xviii., p. 33, September 30. Haplotype, *Helix luteofusca* Cox.

FINDOMELON LUTEOFUSCUM Cox, 1868.

1868. *Helix luteofusca*, Cox, Mon. Austr. Land Shells, p. 52, pl. xii., figs. 1-1a, May. Flinders Range, South Australia (Masters).
South Australia (Flinders Range).

Genus CONTRAMELON Iredale, 1937.

1937. *Contramelon* Iredale, South Austr. Nat., Vol. xviii., p. 34, September 30. Haplotype, *Helix howardi* Angas.

CONTRAMELON HOWARDI Angas, 1869.

1869. *Helix* (? *Plectotropis*) *howardi* Angas, Proc. Zool. Soc. (Lond.), 1869, p. 48, pl. ii., fig. 9, June 21. Arrowie, 450 miles north of Adelaide, South Australia.
South Australia (Arrowie district).

Genus CUPEDORA Iredale, 1933.

1933. *Cupedora* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Orthotype, *Helix lincolniensis* Pfeiffer.

CUPEDORA PATRUELIS Angas, 1864.

1864. *Helix (Hadra) patruelis* Angas, Proc. Zool. Soc. (Lond.), 1863, p. 520, Apr. 20, 1864, ex. A. Adams & Angas M.S. Port Lincoln, South Australia. Fig. Cox. Mon. Austr. Land Shells, p. 49, pl. iii., fig. 8, May, 1868.

1864. *Helix lincolniensis* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 528, April 20, 1864. Evandale, South Australia. Figd. Cox. Mon. Austr. Land Shells, p. 51, pl. vi., fig. 9, May, 1868.
South Australia. (Port Lincoln district).

CUPEDORA EVANDALEANA, Pfeiffer, 1864.

1864. *Helix evandaleana* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 528, Apl. 20, 1864. Evandale, South Australia. Fig. Cox, Mon. Austr. Land Shells, p. 51, pl. ix., fig. 18 March, 1868.

[1878. *Helix induta* Tate, Proc. Linn. Soc., N.S.W., Vol. ii., p. 290, June. Kaisertuhl, South Australia. Not *Helix induta* Pfeiffer, Proc. Soc. (Lond.), 1845, pl. 28, February, 1846.]
South Australia (Evandale district).

CUPEDORA TOMSETTI Tate, 1887.

1887. *Helix tomsetti* Tate, Trans. Roy. Soc. South Austr., Vol. ix., 1886, p. 63, pl. v., figs. 13a-c, March, 1887. Cape Borda. Kangaroo Island, South Australia.
South Australia (Kangaroo Island).

Genus DISCOMELON *nov.*

Type, *D. intricatum sp. nov.*

Shell thin, glossy, flattened, spire scarcely raised, narrowly but perspectively umbilicated, mouth open, outer lip thin. This may be related to *Meracomelon* or to *Meridolum,* but at present its relationships are very obscure.

DISCOMELON INTRICATUM *sp. nov.*

(Plate xii. fig. ii.)

The coloration is pale honey, sometimes showing a pale reddish subsutural band, and a broader anteperipheral band, the under side paler and unbanded. The apex is apparently smooth, an obscure granulation rarely seen, the adult sculpture only showing smoothened growth lines, no granulation visible. The whorls are five and a half, and the largest specimen (type) measures 20 mm. in breadth, and 10 mm. in height. Collarenebri, N.S.W. (Jackson).

Northern New South Wales.

Genus SEMOTRACHIA Iredale, 1933.

1933. *Semotrachia* Iredale, Rec. Aust. Mus., Vol. xix., p. 51, August 2. Orthotype, *Thersites basedowi* Hedley.

1933. *Catellotrachia* Iredale, Rec. Aust. Mus., Vol. xix., p. 52, August 2. Orthotype, *Hadra winneckeana* Tate.

1933. *Spernachloritis* Iredale, Rec. Austr. Mus., Vol. xix., p. 52, August 2. Orthotype, *Hadra setigera* Tate.

SEMOTRACHIA BASEDOWI Hedley, 1905.

1905. *Thersites basedowi* Hedley, Trans. Roy. Soc. South Austr., Vol. xxix., p. 161, pl. xxx., figs. 1-3, December. Musgrave Ranges, Central Australia.
Central Australia (Musgrave Ranges).

SEMOTRACHIA MANNENSIS Iredale, 1937.

1937. *Semotrachia basedowi mannensis* Iredale, South Austr. Nat., Vol. xviii., p. 37, pl. ii., fig. 18, September 30. Mann Range, Central Australia.
Central Australia (Mann Range).

SEMOTRACHIA WINNECKEANA Tate, 1894.

1894. *Hadra winneckeana* Tate, Trans. Roy. Soc. South Austr. Vol. xviii., p. 194, November. Central Australia. Figd. Rep. Horn Sci. Exped. Cent. Austr., pt. ii., Zool. p. 191, pl. xviii., fig. 8, February, 1896 (Spencer Gorge).
Central Australia (Spencer Gorge).

SEMOTRACHIA EUZYGA Tate, 1894.

1894. *Hadra euzyga* Tate, Trans. Roy. Soc. South Austr. Vol. xviii., p. 194, November. Central Australia. Figd. Horn Sci. Exped. Cent. Aust., pl. ii., Zool., p. 190, pl. xvii., fig. 7. February, 1896 (Alice Springs).
Central Australia (Alice Springs).

SEMOTRACHIA SETIGERA Tate, 1894.

1894. *Hadra setigera* Tate, Trans. Roy. Soc. South Australia, Vol. xviii., p. 194, November. Central Australia. Figd. Rep. Horn Sci. Exped. Cent. Aust., pt. ii., Zool., p. 189, pl. xviii., fig. 6, February, 1896. (MacDonnell Ranges).
1896. (*Angasella*) *larapinta* Tate, Rep. Horn Sci. Exped. Cent. Austr. pl. ii., Zool., p. 190, February. New name only.
Central Australia (MacDonnell Ranges).

SEMOTRACHIA ESAU Iredale, 1937.

1937. *Semotrachia esau* Iredale, South Austr. Nat., Vol. xviii., p. 38, pl. i., fig. 11. Krickaueff Ranges, South Australia.
Central Australia (Krickaueff Ranges).

SEMOTRACHIA PAPILLOSA Tate, 1894.

1894. *Hadra papillosa* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 194, November. Central Australia. Figd. Rep. Horn Sci. Exped. Centr. Austr., pt. ii., Zool., p. 191, pl. xviii., fig. 9, February, 1896. No locality ex Rev. H. Kempe.
Central Australia (probably MacDonnell Ranges).

SEMOTRACHIA SUBSECTA Tate 1879

1879. *Helix subsecta* Tate, Trans. Proc. Phil. Soc. Adelaide, South Austr., 1878-9, p. 133, pl. v., fig. 2a-b., after October. Port Wakefield, South Australia (Mrs. Kreusler).
South Australia (exact locality not certain).

Genus DIRUTRACHIA Iredale, 1937.

1937. *Dirutrachia* Iredale, South Austr. Nat., Vol. xviii., p. 36, September 30. Orthotype, *Hadra sublevata* Tate.

DIRUTRACHIA SUBLEVATA Tate.

1894. *Hadra sublevata* Tate, Trans. Roy. Soc. South Austr., Vol., xviii, p. 192, November. Central Australia. Fig. Rep. Horn Sci. Exped. Cent. Austr., pt. ii., p. 196, pl. xvii., fig. 5, February, 1896 (Hart Ranges).
Central Australia (Hart Ranges).

DIRUTRACHIA MERSA Iredale, 1937.

1937. *Semotrachia mersa* Iredale, South Austr. Nat., Vol. xviii., p. 38, pl. ii., fig. 9, September 30. Musgrave Ranges, C.A.
Central Australia (Musgrave Ranges).

Genus LACUSTRELIX Iredale, 1937.

1937. *Lacustrelix* Iredale, South Austr., Nat., Vol. xviii., p. 39, September 30. Haplotype, *Helix eyrei* H. Adams & Angas.

LACUSTRELIX EYREI H. Adams & Angas, 1876.

1876. *Helix eyrei* H. Adams & Angas, Proc. Zool. Soc. (Lond.), 1876, p. 489, pl. xlvii., figs. 10-12, October 1. Shores of Lake Eyre, Central Australia.

1877. *Helix eyrensis* Martens, Zool. Record, 1876, Moll., p. 44, emend. only.
South Australia (Lake Eyre district).

Genus VIDUMELON Iredale, 1933.

1933. *Vidumelon* Iredale, Rec. Austr. Mus., Vol. xix., p. 51, August 2. Orthotype, *Hadra wattii* Tate.

VIDUMELON WATTII Tate, 1894.

1894. *Hadra wattii* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 192, November. Central Australia. Figd. Rep. Horn. Sci. Exped. Cent. Austr., pt. ii., Zool., p. 201, pl. xviii., fig. 12, February, 1896 (Maude River, Hart Ranges).
Central Australia (Hart Ranges).

Family PAPUINIDAE.

The species classed under *Papuina* are here given family rank, so that definiteness may be achieved in distinguishing Helicoid molluscs. They are mostly tree-living, of delicate texture, with elevated trochoid form, and light or bright coloration. The Australian forms are of diverse facies and obviously of different origin, and all belong to the Papuan or Torresian faunula. None is referable to the typical genus, *Papuina* Martens (Die Heliceen (Albers), 2nd ed., pl. xiv, 166, 1861), based on *Helix lituus* Lesson, and of which *Eugenia* Albers (loc. cit.) and *Insularia* Tapparone-Canefri (Ann. Mus. Civ. Genov., Vol. xix., pl. 115, 138, 1883) are absolute synonyms.

Genus RHYNCHOTROCHUS Möllendorff, 1895.

1895. *Rhynchotrochus* Möllendorff, Proc. Mal. Soc. (Lond.), Vol. i., p. 237, March. Logotype, Zool. Rec., 1895, Moll., p. 56, 1896. *tayloriana*.

1933. *Papuexul* Iredale, Rec. Austr. Mus., Vol. xix., p. 41, August 2. Orthotype, *Helix bidwilli* Pfeiffer .

1933. *Noctepuna* Iredale, Rec. Austr. Mus., Vol. xix., p. 41, August 2. Orthotype, *Helix poiretiana* Reeve.

RHYNCHOTROCHUS MACGILLIVRAYI Forbes, 1851.

1851. *Helix macgillivrayi* Forbes, Narr. Voy. Rattlesnake, (Macgillivray), Vol. ii., p. 378, pl. iii., fig. 1, 1852 = mid-December, 1851. Frankland Island, North Queensland.
North Queensland.

Note.—The mainland form, especially north of Cairns, is much broader with a more elongate mouth, the upper part of the outer lip more twisted

and incurved, and may be called *R. macgillivrayi extensior subsp. nov.*, the type measuring 25 mm. in breadth by 20 mm. in height. (Plate xii., fig. 3).

RHYNCHOTROCHUS POIRETIANUS Reeve, 1852.

1852. *Helix poiretiana* Reeve, Conch. Icon., Vol. vii., pl. lxxix, sp. 418, March 11, ex Pfeiffer (Proc. Zool. Soc. (Lond.), 1851, p 254, July 26, 1853), Port Essington, error = Night I., Queensland.
North Queensland (Night Island).

RHYNCHOTROCHUS BIDWILLI Reeve, 1853.

1853. *Helix bridwilli* (sic.) Reeve, Conch. Icon., Vol. vii., pl. 157, sp. 1034, May. Wise Bay, Queensland (F. C. Bridwill).

1854. *Helix bridwilli* Pfeiffer, Proc. Zool. Soc. (Lond.), 1853, p. 49, July 25, 1854, name corrected to *bidwilli*. Figd. Cox, Mon. Austr. Land Shells, p. 63, pl. ii. fig. 3, May, 1868.
South Queensland. Northern New South Wales.

Genus POSORITES Iredale, 1933.

1933. *Posorites* Iredale, Rec. Austr. Mus., Vol. xix., p. 42, August 2. Orthotype, *Helix fricata* Pfeiffer.

POSORITES FUCATA Pfeiffer, 1853.

1853. *Helix fucata* Pfeiffer, Zeitsch, für. Malak., Vol. x., p. 56, March: Proc. Zool. Soc. (Lond.), 1853, p. 58, July 25, 1854. Wide Bay, Queensland. Figd. Reeve, Conch Icon., Vol. vii., pl. 157, sp. 1029, May, 1853. Cox, Mon. Austr. Land Shells p. 67, pl. ii., fig. 8, May, 1868.
South Queensland.

POSORITES CONSCENDENS Cox, 1866.

1866. *Helix conscendens* Cox, Proc. Zool. Soc. (Lond.), 1866, p. 374, September 5. Richmond River, New South Wales (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 67, pl. ii., fig. 6, May, 1868.
Northern New South Wales.

POSORITES MAYANA Hedley, 1899.

1899. *Papuina mayana* Hedley, Rec. Austr. Mus., Vol. iii., p. 151, pl. xxviii., figs. 10-11, December 11. Upper Annan River, Cooktown, Q. (Miss E. Hatfield).
North Queensland.

POSORITES CEREA Hedley, 1894.

1894. *Papuina cerea* Hedley, Nautilus, Vol. vii., p. 136, text fig., April. Vict. Naturalist, Vol. xi., p. 30, April. Blomfield River, North Queensland (W. D. Le Souef).
North Queensland.

POSORITES MUENSIS Hedley, 1912.

1912. *Papuina muensis* Hedley, Rec. Austr. Mus., Vol. viii., p. 154, pl. xlix., figs. 44-45, May 6. Mua I., Torres Strait.
North Queensland (Torres Strait's Islands).

POSORITES TURNERI Shirley, 1921.

1921. *Papuina turneri* Shirley, Queensland Naturalist, Vol. iii., p. 36, fig. in text, October. National Park, South Queensland.
South Queensland.

Genus RACHISPECULUM Iredale, 1933.

1933. *Rachispeculum* Iredale, Rec. Austr. Mus., Vol. xix., p. 42, August 2. Orthotype, *Bulimus bidwilli,* Cox.

RACHISPECULUM BIDWILLI Cox, 1868

1868. *Bulimus bidwilli* Cox, Mon. Austr. Land Shells, p. 72, pl. xiii., fig. 11, May. Burnett River, South Queensland (Bidwill).

1893. *Papuina folicola* Hedley, Nautilus, Vol. vii., pp. 73-74, November. New name for preceding.
South Queensland.

Genus AMIMOPINA Iredale, 1933.

1933. *Amimopina* Iredale, Rec. Austr. Mus., Vol. xix., p. 42, August 2. Orthotype, *Bulimus beddomei* Brazier.

AMIMOPINA BEDDOMEI Brazier, 1880.

1880. *Bulimus beddomei* Brazier, Proc. Linn. Soc. N.S.W., Vol. iv., p. 394, May: Torres Strait (ex id. Proc. Linn. Soc. N.S.W., Vol. i., p. 127, July, 1876, *nomen nudum*). Fig. Pilsbry Man. Conch. (Tryon), Ser. 2, Vol. xiii., p. 121, pl. 4, fig. 68, 1900.
[*Bulimus macleayi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 108, July, 1876. Yule Island, New Guinea is a distinct species.]
North Queensland.

Family CHLORITIDAE.

Under the generic name *Chloritis* a large assemblage of land shells has been created. The essential features of the original *Chloritis* were a hairy shell associated with a pustulate protoconch, flattened spire and wide umbilicus. At present the series includes non-hairy shells with smooth protoconch, elevated spires and imperforate. There is however, a general superficial resemblance, striking features being the thinness of the shells and uniform brownish coloration. Gude making a study of this group named a number of species, and fortunately most of the types and paratypes are available. An attempt is here made to sort out the forms, and group them into series so that it may become easier to allot new species accurately.

Genus AUSTROCHLORITIS Pilsbry, 1891.

1891. *Austrochloritis* Pilsbry, Man. Conch. (Tryon), 2nd. Ser., Vol. vi., pp. 242, 262, May 1. Orthotype, *Helix porteri,* Cox.

AUSTROCHLORITIS PORTERI Cox, 1866.

1866. *Helix porteri* Cox, Proc. Zool. Soc. (Lond.), 1866, p. 373, September 5. Guy Faux Station, Upper Clarence River, N.S.W. (Porter). Figd. Cox, Mon. Austr. Land Shells, p. 48, pl. iii., fig. 6, May, 1868.
Northern New South Wales.

AUSTROCHLORITIS ASTAEUS Gude 1906.

1906. *Chloritis astaeus* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 108, pl. xiii., figs. 6a-c., June 29, ex Brazier MS. Cardwell, North Queensland.
North Queensland.

AUSTROCHLORITIS AGAMEMNON Gude, 1906.

1906. *Chloritis agamemnon* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 108, pl. xiii., figs. 7a-c., June 29, ex Brazier MS. Near Cardwell, North Queensland.
North Queensland.

AUSTROCHLORITIS FRINGILLA *sp. nov.*
(Plate xii., fig. 6.)

Similar to *A. porteri,* but smaller with the spire a little more elevated, the umbilicus more hidden, and the hairs shorter and more numerous. Breadth, 15 mm.; height, 11 mm. Type from Finch Hatton, near Mackay, Queensland (S.W. Jackson).

Mid Queensland (Mackay district).

AUSTROCHLORITIS BREVIPILA Pfeiffer, 1850.

1850. *Helix brevipila* Pfeiffer, Proc. Zool. Soc. (Lond.), 1849, p. 130, January-June, 1850. East Coast of New Holland (Strange) = Bellenger River, New South Wales, selected by Gude. Figd. Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, pl. 124, figs. 28-30, ante 1852. Reeve, Conch. Icon., Vol. vii., pl. 128, sp. 777, October, 1852. Type figured by Gude, Proc. Mal. Soc. (Lond.), Vol. vii., p. 48, pl. iv., fig. 9, March 9, 1906.
Northern New South Wales.

AUSTROCHLORITIS METUENDA *sp. nov.*
(Plate xii., fig. 9.)

Allied to *brevipila,* as selected by Gude, but larger with the umbilicus more covered, but the mouth more open. Breadth, 13 mm.; height, 8 mm.
Illawarra, New South Wales.
Southern New South Wales. ? Victoria.

AUSTROCHLORITIS LAYARDI Gude, 1906.

1906. *Chloritis layardi* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 49, pl. v., figs. 4a-c., March 9. Islands in Torres Str.
North Queensland (Torres Straits Islands).

AUSTROCHLORITIS BILABIATA Odhner, 1917.

1917. *Chloritis bilabiata* Odhner, Kungl. Svensk. Vetensk. Handl., Bd. 52, No. 16, p. 85, pl. 3, figs. 94-96, text-figs. 42-43, September 19. Malanda, North Queensland.
North Queensland.

AUSTROCHLORITIS BLIGHIANA *sp. nov.*
(Plate xii., fig. 10.)

Similar to *layardi* Gude, but with the apex a little elevated, not sunken, a little larger, the umbilicus smaller, the mouth descending with callus connecting lips. Breadth, 10 mm.; height, 7 mm. Type from Restoration Island, Queensland.

North Queensland (Restoration Island).

Note.—There are apparently, at least two series included in *Austrochloritis,* and the subgeneric name *Nannochloritis* is introduced, with *layardi* Gude as type, for the smaller species.

AUSTROCHLORITIS SENTICULA *sp. nov.*
(Plate xii., fig. 12.)

Related to *layardi* Gude, with the spire a little elevated, the sutures deeper, the hairs more distant, and the umbilicus more concealed. The height is 6 mm., the breadth 10 mm. Miriam Vale, near Port Curtis, Queensland.
South Queensland (Port Curtis district).

AUSTROCHLORITIS DISJUNCTA Gude, 1906.

1906. *Chloritis disjuncta* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 49, pl. v. figs. 3, 3a, March 9. Port Stephen (s), New South Wales.
Mid New South Wales.

AUSTROCHLORITIS NOVOCAMBRICA Gude, 1906.

1906. *Chloritis novocambrica* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 49, pl. v., figs. 2a-c., March 9. New South Wales = Bellenger River.
Northern New South Wales.

AUSTROCHLORITIS SEPARANDA *sp. nov.*

(Plate xii., fig. 13.)

Larger than the preceding, spire more elevated, umbilicus wider, hairs more distant. Breadth, 15 mm.; height, 11.5 mm. Type from North Pine River, South Queensland.

South Queensland.

AUSTROCHLORITIS BUXTONI Brazier, 1880.

(Plate xii., fig. 14.)

1880. *Helix (Planispira) buxtoni* Brazier, Proc. Linn. Soc. N.S.W., Vol. iv., p. 394, May. Thursday Island, Torres Strait.
North Queensland (Islands in Torres Strait).

Note.—Shells marked as typical by Brazier himself show hair scars, the hairs apparently being long and rather distant; the shells have flattened spire with granulated apex, a wide umbilicus, but the outer lip of the mouth shows expansion, in a specimen from Sue Island, almost flaring and recalling *Torresitrachia,* as if they might be hairy derivatives. In order to keep this point in view, the subgeneric name *Patrubella* is proposed with *buxtoni* as type.

Genus TOLGACHLORITIS Iredale, 1933.

1933. *Tolgachloritis* Iredale, Rec. Austr. Mus., Vol. xix., p. 50, August 2. Orthotype, *Chloritis jacksoni* Hedley.

TOLGACHLORITIS JACKSONI Hedley, 1912.

1912. *Chloritis jacksoni* Hedley Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 256, pl. v., figs. 13-16, December 13. Near Cairns, North Queensland.
North Queensland.

Genus MUSSONENA *nov.*

Type, *Helix spinei* Cox.

The species is flattened, narrowly umbilicate, mouth open, outer lip thin, columella scarcely reflected. The apex is obscurely granulose, and the adult shell is clothed with widely spaced long stiff hairs.

MUSSONENA SPINEI Cox, 1868.

1868. *Helix spinei* Cox, Mon. Austr. Land Shells, add. page, 111, post. May. New name for

1868. *Helix hystrix* Cox, Mon. Austr. Land Shells, p. 48, pl. xviii. figs. 5a-b., May. Port Curtis, Queensland. Not *H. hystrix* Pfeiffer, Symb. Helic., pt. iii., p. 67, 1846.

1907. *Chloritis munda* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 229, pl. xxi., figs. 2a-d., April 3. Moon Creek, Burnett River, Queensland.
South Queensland.

MUSSONENA CAMPBELLI *sp. nov.*
(Plate xii., fig. 15.)

Similar to *spinei* Cox, but spire a little elevated, hairs longer, widely spaced, umbilicus deep, narrow, lip thin. Height, 7mm.; breadth, 10 mm. Type from Chillagoe Caves, N.Q. (W. D. Campbell).
North Queensland (Chillagoe Caves district).

Genus NEVERITIS *nov.*
Type, *Chloritis poorei* Gude.

These small shells appear to be hairless, but show granulation, which has suggested hair bearing scars; the texture is unlike that of the preceding, and the form also differs.

NEVERITIS POOREI Gude, 1907.

1907. *Chloritis poorei* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 231, pl. xxi., figs. 7a-d., April 3. Cardwell, North Queensland.
North Queensland (Cardwell district).

NEVERITIS MISELLA Gude, 1907.

1907. *Chloritis misella* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 232, pl. xxi., figs. 9a-d., April 3. Queensland.
Queensland.

NEVERITIS THALES Gude, 1907.

1907. *Chloritis thales* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 232, pl. xxi., figs. 8a-d., April 3. Rockingham Bay, Queensland.
North Queensland (Rockingham Bay district).

NEVERITIS ARIDORUM Cox, 1866.

1866. *Helix aridorum* Cox, Journ. de Conch., Vol. xiv., p. 47, January 1. Proc. Zool. Soc. (Lond.), 1865, p. 695, April 24, 1866. Clarence River, New South Wales (Macgillivray).

1868. *Helix avidorum* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 724, April 3, 1868. Clarence River, New South Wales (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 44, pl. xi., figs. 16, 16a., May, 1868. Refigd. Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 257, pl. vi., figs. 20-23, December 13, 1912 (North Brisbane specimen).
Northern New South Wales. South Queensland.

Genus OFFACHLORITIS Iredale, 1933.

1933. *Offachloritis* Iredale, Rec. Austr. Mus., Vol. xix., p. 50, August 2. Orthotype, *Helix dryanderensis* Cox.

OFFACHLORITIS DRYANDERENSIS Cox, 1872.
(Plate xii., fig. 16.)

1872. *Helix dryanderensis* Cox, Proc. Zool. Soc. (Lond.), 1872, p. 19, June. Mount Dryander, Port Denison, Queensland.
Mid Queensland.

Genus OBSTEUGENIA Iredale, 1933.

1933. *Obsteugenia* Iredale, Rec. Austr. Mus., Vol. xix., p. 50, August 2. Orthotype, *Chloritis inflecta* Hedley.

OBSTEUGENIA INFLECTA Hedley, 1912.

1912. *Chloritis inflecta* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 256, pl. iv., figs. 9-11, December 13. Tinaroo, North Queensland.
North Queensland.

Genus CHLORITISANAX Iredale, 1933.

1933. *Chloritisanax* Iredale, Rec. Austr. Mus., Vol. xix., p. 49, August 2. Orthotype, *Helix banneri* Pfeiffer.

CHLORITISANAX BANNERI Pfeiffer, 1863.

1863. *Helix banneri* Pfeiffer, Proc. Zool. Soc. (Lond.), 1862, p. 270, April 20, 1863, ex Macgillivray MS. Cape Direction, North Queensland (Macgillivray). Figd. Cox, Mon. Austr. Land Shells, p. 6, pl. xx., fig. 6, May, 1868, from a painting of the type by Angas.
North Queensland.

Genus RAMOGENIA *nov.*

Type, *Chloritis obnubila* Gude, 1907.

Shells recalling *Austrochloritis* in general appearance, but with no trace of hair scars, and obviously no hairs, therefore not a *Chloritis* even in a general sense.

RAMOGENIA OBNUBILA Gude, 1907.

1907. *Chloritis obnubila* Gude, Proc. Mal. Soc. (Lond.), Vol. vii., p. 232, pl. xxi. figs. 10a-b., April 3. Australia = South Queensland.
South Queensland.

RAMOGENIA CHALLENGERI Gude, 1906.

1906. *Chloritis challengeri* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 108, pl. xiii., figs. 5a-b., June 29. Queensland (Challenger) = South Queensland.
South Queensland.

RAMOGENIA LANUGINOSA Gude, 1907.

1907. *Chloritis lanuginosa* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 230, pl. xxi., figs. 3a-d., April 3. Eidsvold, South Queensland.
South Queensland.

RAMOGENIA MUCIDA Pfeiffer, 1857.

1857. *Helix mucida* Pfeiffer, Proc. Zool. Soc. (Lond.), 1856, p. 329, March 10, 1857. Percy's Isle, Queensland. Figd. Cox, Mon. Austr. Land Shells, p. 59, pl. xix., figs. 7, 7a., May, 1868, from a painting of the type by Angas.
Mid Queensland (Percy's Isle).

Genus DAMOCHLORA *nov.*

Type, *Helix millepunctata* Smith.

These Westralian species have flattened shells, widely umbilicated, thin, open mouth, spire a little elevated, sculpture minute punctations or granulation, and do not seem to be related to Eastern groups.

DAMOCHLORA MILLEPUNCTATA Smith, 1894.

1894. *Helix (Chloritis) millepunctata* Smith, Proc. Malac. Soc. (Lond.), Vol. I., p. 88, pl. vii., fig. 11, June. Baudin Is., N.W.A.
North West Australia (Baudin Island).

DAMOCHLORA CASSINIENSIS Smith, 1894.

1894. *Helix (Chloritis) millepunctata* var. *cassiniensis* Smith, Proc. Malac. Soc. (Lond.), Vol. I., p. 88, pl. vii., fig. 12, June. Cassini Is. N.W.A.
North West Australia (Cassini Is.).

DAMOCHLORA RECTILABRUM Smith, 1894.

1894. *Helix (Chloritis) rectilabrum* Smith, Proc. Malac. Soc. (Lond.), Vol. I., p. 88, pl. vii., fig. 14, June. Parry Harbour, N.W.A.
North West Australia (Parry Harbour district).

Genus GLOREUGENIA Iredale, 1933.

1933. *Gloreugenia* Iredale Rec. Austr., Mus., Vol. xix., p. 50, August 2. Orthotype, *Helix coxeni* Cox.

GLOREUGENIA COXENI Cox, 1871.

1871. *Helix coxeni* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 54, pl. iii., fig. 12, June 12. Whitsunday Island, North Queensland.
Mid Queensland (Whitsunday Island).

GLOREUGENIA EXILIS Gude, 1907.

1907. *Chloritis exilis* Gude, Proc. Mal. Soc. (Lond.), Vol. vii., p. 230, pl. xxi., figs. 4a-d., April 3. Mount Dryander, Port Denison Queensland.
Mid Queensland.

GLOREUGENIA COGNATA Gude, 1907.

1907. *Chloritis cognata* Gude, Proc. Mal. Soc. (Lond.), Vol. vii., p. 231, pl. xxi., figs. 5a-d, April 3. Olsen's Caves, Rockhampton, Queensland.
South Queensland.

GLOREUGENIA CARDUELIS *sp. nov.*
(Plate xiii., fig. 1.)

Similar to *coxeni* Cox, but much larger, with the umbilicus more covered, and the hairs more distinct. Breadth, 27 mm.; height, 22.5 mm. Type from Finch Hatton, near Mackay Queensland, collected by G. M. Goldfinch.
Mid Queensland.

GLOREUGENIA HEDLEYI Fulton, 1906.

1906. *Chloritis (Austrochloritis) hedleyi* Fulton, Proc. Malac. Soc. (Lond.), Vol. vii., p. 362, figs. in text, September. Herbert River scrubs, N.Q.
North Queensland.

GLOREUGENIA PRAECURSORIS Hedley, 1912.

1912. *Chloritis cognata* var. *praecursoris* Hedley, Proc. Linn. Soc. N.S.W., Vol. xxxvii., p. 257, pl. v., figs. 17-19, December 13. West of Finch Hatton, 50 miles West of Mackay, Queensland.
Mid Queensland.

GLOREUGENIA BLACKALLI Brazier, 1875.
(Plate xii., fig. 26.)

1875. *Helix (Dorcasia) blackalli* Brazier, Proc. Linn. Soc. N.S.W., Vol. I., p. 1, April 27. Mount Dryander, near Port Denison, Queensland.
Mid Queensland.

Genus CALVIGENIA *nov.*
Type, *Helix blackmani* Cox.

This form agrees with *Gloreugenia* in general form, but is not hair-bearing, a velvety pustulose periostracum being seen instead. The apex is not granulated but radially striate.

CALVIGENIA BLACKMANI Cox, 1868.

1868. *Helix blackmani* Cox, Mon. Austr. Land Shells, p. 45, pl. xi., figs. 7-7a, May. Warroo, Port Curtis, Queensland (Blackman).
South Queensland.

CALVIGENIA DAINTREEI Brazier, 1875.

1875. *Helix (Xanthomelon) daintreei* Brazier, Proc. Zool. Soc. (Lond.), 1875, pl. iv., fig. 8 June. "Muggerbaa, Moreton Bay". Error = Chinchilla, *fide* Hedley.
South Queensland.

CALVIGENIA BENNETTI Brazier, 1872.

[1872. *Helix (Hadra) bennetti* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 639, May 2, 1872. Ipswich, Queensland.
South Queensland.

Note.—The identity of this species is indeterminable at present.]

Genus PARGLOGENIA *nov.*

Type, *Helix pelodes* Pfeiffer.

Shell similar in form to *Gloreugenia,* but being granulose and lacking hairs with the apex slightly granulose suggests the valuelessness of hair characters. *Kimboraga* has neither hairs nor grains, yet is of similar form.

PARGLOGENIA PELODES Pfeiffer, 1846.

1846. *Helix pelodes* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 126, February, 1846. North Coast (Ince). = Port Essington (Macgillivray). Figd. Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.) ed. Kuster, pl. 58, figs. 6-7, ante 1852. Reeve, Conch. Icon., Vol. vii., pl. lxviii., sp. 353, January, 1852 (*prunum*).

1893. *Chloritis pseudoprunum* Pilsbry, Man. Conch. (Tryon), Ser. 2, Vol. viii., p. 271, pl. 55, figs. 13-15, July 1. North-western Australia = Port Darwin, Northern Territory.
Northern Territory.

PARGLOGENIA SUBGRANOSA Le Guillou, 1842.

1842. *Helix subgranosa* Le Guillou Revue Zool., 1842, p. 137, Mai no = June. North Australia. = Raffles Bay.
Northern Territory.

Note.—This appears to be the correct name for the preceding, but certainty is not yet.

PARGLOGENIA FORRESTIANA Angas, 1875.

1875. *Helix forrestiana* Angas, Proc. Zool. Soc. (Lond.), 1875, p. 389, pl. xlv., figs. 3, 3a, October 1. North West Australia.
North West Australia.

Genus KIMBORAGA Iredale, 1933.

1933. *Kimboraga* Iredale, Rec. Austr. Mus., Vol. xix., p. 50, August 2. Orthotype, *Chloritis micromphala* Gude.

KIMBORAGA MICROMPHALA Gude, 1907.

1907. *Chloritis micromphala* Gude, Proc. Malac. Soc. (Lond.), Vol. vii., p. 231, pl. xxi., fig. 6, April 3. Barrier Range, North West Australia.
North West Australia.

[HELIX PRUNUM Férussac, 1819.

1819. *Helix prunum* Férussac, Hist. Moll., pl. xxvi., figs. 7, 8, 9; Tabl. Syst. Moll., p. 29, January, p. 25, June, 1821. Les Terres Australes; voyage de Péron, nom. nud.

1902. *Helix prunum* Fischer, Journ. de Conch., Vol. 50, pp. 385-6.

Although this name has been used for the species here named *Parglogenia pelodes*, it has been shown to be unrelated, but its identity is still unknown.]

Family Xanthomelontidae.

The typical shells of *Xanthomelon* have been dissected and shown to have an anatomy distinct from those of typical *Hadra*. These differences have been traced through a series of shells with rather unlike shell characters, and these are here grouped, though with great reservation. The typical *Xanthomelon* in the Northern Territory appears to show four distinct species, all large shells. Two are openly perforate, two have the umbilicus closed, two have the columella smooth and two the inner lip granulose. If these were otherwise distributed, they might have been regarded as forms only, but here they are seen to be clearly different entities. In Queensland a different state of affairs is seen as the largest shell always has the perforation covered and the columella and inner lip smooth. This form varies in size and form from north to south, and perhaps many species are being confused. Alongside two smaller shells are living, one with the umbilicus open the other with the perforation closed. The differentiation of these shells is difficult as all have the same general form and coloration, being a uniform green.

A collection from the Northern Territory received as this was going through the press indicates that there are many more local forms than hitherto recognised, Melville Island, Croker Island, Goulburn Island, &c., all showing representative series.

Genus Xanthomelon Martens, 1861.

1861. *Xanthomelon* Martens, Die Heliceen (Albers), 2nd. ed., pp. xv., 174. Orthotype, *Helix pomum* Pfeiffer = *Helyx durvillii* Hombron & Jacquinot.

Xanthomelon durvillii Hombron & Jacquinot, 1841.

1841. *Helyx durvillii* Hombron & Jacquinot, Ann. Sci. Nat. (Paris), Ser. ii., Vol. xvi., p. 62, July. Raffles Bay, New Holland. Figd. Voy. au Pôle Sud., Atlas, Moll., pl. 3, figs. 1-3, 1851.; Vol. v., p. 1, 1854.

1842. *Helix pomum* Pfeiffer, Symb., hist., Helic., Vol. ii., p. 37. "New Zealand?" Error = Port Essington, North Australia. Figd. Syst. Conch. Cab. (Mart & Chemn), ed. Kuster, Bd. I., Abth. xiii., pl. 55 figs. 11-13. Cox, Mon. Austr. Land Shells, p. 40, pl. iv., fig. 7, May, 1868. Northern Territory.

Xanthomelon spheroideum Le Guillou, 1845.

1845. *Helix spheroidea* Le Guillou, Revue Zool. Soc. (Cuv.), 1845, p. 188. May no = June. Essington Bay, North Australia.

1868. *Helix edwardsi* Cox, Mon. Austr. Land Shells, p. 109, pl. xix., fig. 3, May. Liverpool River, North Coast Australia (Edwards). Not *Helix edwardsi* Bland, Ann. N.Y. Lyc. Nat. Hist., Vol. vi., p. 277, 1858.

1869. *Helix nigrilabris* Martens, Malak. Blatt., Vol. xvi., p. 79. Figd. Nov. Conch., p. 45, pl. 118, fig. 45. Interior South Australia.

1871. *Helix (Galaxias) meadei* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 662, May 2. New name for *H. edwardsi* Cox.

1876. *Helix pseudomeadei* Bednall, South Australia (Harcus), p. 186 (ded. January), ex Brazier MS. Port Darwin, North Australia. Northern Territory.

XANTHOMELON LYNDI Angas, 1872.

1872. *Helix (Xanthomelon) lyndi* Angas, Proc. Zool. Soc. (Lond.), 1872, p. 610, pl. xlii., fig. 1, November 3. Port Essington, North Australia. Northern Territory.

XANTHOMELON INTERPOSITUM *sp. nov.*

(Plate xiii., fig. 2.)

Shells, collected by Mr. T. G. Campbell at Burnside Station, Brock's Creek, Northern Territory, recall *pachystylum* in form, but show the ripple marking of *durvillii*; they are globose, with the perforation closed, the columella thickened, semitoothed, the outer lip not so expanded as in *durvillii*, the inner lip smooth, the aperture white, the outside clouring dark olive green almost brown. Height, 33 mm.; breadth, 36 mm.

Northern Territory (Brock's Creek).

XANTHOMELON PACHYSTYLUM Pfeiffer, 1845.

(Plate xiii., fig. 4.)

1845. *Helix pachystyla* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 71, October. "New Zealand". Error = Port Curtis, Queensland. Figd. Reeve, Conch. Icon., Vol. vii., pl. lxx., sp. 364, January, 1852.

1894. *Thersites pachystyla* var. *subfuscozonata* Cox, Proc. Linn. Soc. N.S.W., Vol. xxiii., p. 650, May. Colour variety only = Port Curtis. Queensland.

Note.—The original shell was in the Mus. Metcalfe, measuring 43 mm. by 37 mm. The type is missing as that collection was dissipated. When MacGillivray collected the species in 1847 at Facing Island, he noted it as a new species, so obviously he had not collected it on the earlier trip in the "Fly". Consequently some locality must be selected, and as shells from Port Curtis generally agree, this is here definitely designated as the type locality. Probably many forms will be later differentiated, but two or three obvious ones must be here designated. Thus from the Whitsunday Islands the shells are very large and broad, measuring 52 mm. across, but are also tall, the height being 54 mm., the spire conical and about equal to the aperture. In Port Curtis shells the spire is more rounded and the norm measures 38 mm. in height and 40 mm. in breadth.

On the other hand, specimens from Chillagoe, North Queensland, are about the same size as those from the type locality, but are broad, with the spire little elevated. In all these the sculpture of the apex is slightly granulose but on the succeeding whorls a fine criss-cross lining can be seen disappearing on the body whorl where only concentric lines remain, vanishing below the periphery. When long series are examined from the length of Queensland many forms will be diagnosed, but at present only the extremes are being named subspecifically.

Thus the Whitsunday Islands' shells are all large and these are named *Xanthomelon pachystylum magnidicum subsp. nov.* (Plate xiii., fig. 9), the type being the Whitsunday Island specimen here figured. The Chillagoe shells have a short spire and are rather obese, and the shell figured measures 32 mm. in height, while its breadth is 37 mm. This series is named *X. p. saginatum subsp. nov.* (Plate xiii., fig. 3). Living alongside these large shells are small shells of somewhat similar form and coloration, but these can be distinguished by their sculpture, this being of the ripple nature seen in *durvillii*. A further complication occurs in that a shell superficially of the same colour, form and sculpture is openly umbilicate after the manner

of *durvillii.* The latter is known as *jannellei,* and it has the outer lip as in *pachystylum,* and the columella shows no flattening nor appression. From Keswick Island, one of southern islets of the Whitsunday Group, comes a dwarf form of *pachystylum,* a shell measuring 32 mm in breadth by 28.5 mm. in height. It is solid with the spire short, but conical, the sculpture notably criss-cross and the columella broad, flattened and closely appressed entirely closing the umbilicus. This may be called *Xanthomelon pachystylum noscitum subsp. nov.* (Plate xiii., fig. 8).

Xanthomelon jannellei Le Guillou, 1842.
(Plate xiii., fig. 10.)

1842. *Helix jannellei* Le Guillou, Revue Zool. Soc. Cuv., 1842, p. 137, Mai no = June. North Australia = Torres Strait.

1868. *Helix pachystyloides* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 725, April 3, 1868; Mon. Austr. Land Shells, p. 41, pl. v., fig. 4, May, 1868. Cape York, Queensland (Dämel).
North Queensland (Cape York).

Xanthomelon genetivum *sp. nov.*
(Plate xiii., fig. 14.)

Dead shells collected at Forsyth Island retain traces of vivid coloration, similar to that of *"nigrilabris"*, but are smaller, the spire a little elevated, the granulation on the columella and inner lip being very much weaker, the outer lip not so reflected. The type is a greenish shell with the columella, inner lip and edge of outer lip brownish pink, and measures: height, 34 mm. by breadth, 31 mm.

Queensland (Forsyth Is., Wellesley Group).

Shells from Bentinck Island in the same group are dead and smaller with the spire more depressed; the coloration has been greenish and the columella, inner lip and outer lip are white, the inner lip showing granulation. The type measures: height, 25 mm. by breadth, 27 mm., and this for the present may be subspecifically named *X. genetivum lubricum subsp. nov.* (Plate xiii., fig. 11).

Xanthomelon minusculum *sp. nov.*
(Plate xiii., fig. 13.)

Dead shells collected at Observation Island, Sir Edward Pellew Group, are miniatures for this genus, the largest reaching 24 mm. in height by the same breadth, but fully formed shells may measure only 19 mm. in height by 20 in breadth. The coloration has been green, the sculpture ripple markings, the mouth open, the outer lip expanded, the inner lip faintly granulose. The whole facies is that of the *durvillii* series, to which it may be related.

Northern Territory (Sir Edward Pellew Group).

Xanthomelon daemelii Martens, 1869.

1869. *Helix pachystyla* var. *daemelii* Martens, Malak. Blatter., Vol. xvi. p. 78, April. Cape York, Queensland (Damel).
North Queensland (Cape York).

Xanthomelon distractum *sp. nov.*
(Plate xiii., fig. 16.)

Shell small, recalling *pachystylum,* but with ripple markings. Coloration yellowish green. The columella is flattened and appressed closing the

umbilicus. Spire depressed making the shell broader than high, the measurements being: height 25 mm., breadth 30. Type from Mount Allam, Berseker Ranges (H. Bernhard).

South Queensland (Port Curtis district).

Genus SINUMELON Iredale, 1930.

1930. *Sinumelon* Iredale, Vict. Naturalist, Vol. xlvii., p. 120, November. Haplotype, *Helix nullarborica* Tate.

1932. *Notobadistes* Cotton & Godfrey, South Austr. Naturalist, Vol. xiii., pp. 169-170, "August" = September 30. Orthotype, *Helix bitaeniata* Cox = *flindersi* Angas.

SINUMELON NULLARBORICUM Tate, 1879.

1879. *Helix nullarborica* Tate, Trans. Proc. Phil. Soc. Adelade, South Austr., 1879-9 p. 133, pl. vi., figs. 1a-b., ex p. 126, *nom. nud.* Bunda Plateau, Nullarbor Plain, South Australia.
South Australia (western limit). South West Australia (eastern limit).

SINUMELON BEDNALLI Ponsonby, 1904.

1904. *Xanthomelon bednalli* Ponsonby, Proc. Mal. Soc. (Lond.), Vol. vi., p. 182, fig. in text, September. MacDonnell Range, Central Australia.
Central Australia (MacDonnell Ranges).

SINUMELON GODFREYI Iredale, 1933.

1933. *Sinumelon godfreyi* Iredale, Rec. Austr. Mus., Vol. xix., p. 52, August 2. New name for

1862. *Helix angasiana* Pfeiffer, Journ. de Conch., Vol. x., p. 228, pl. x. fig. 2, July 1. Near Lake Torrens, South Australia (= Arrowie, Angas, Journ. Conch. (Leeds), Vol. i., p. 135, 1876). Refigd. Angas, Proc. Zool. Soc. (Lond.), 1876, p. 268, pl. xx., figs. 13-14. Not *Helix angasiana* Newcombe, Ann. Lyc. New York, Vol. vii., p. 283, May, 1860.
South Australia (East of Lake Torrens).

SINUMELON EUPESUM Iredale, 1937.

1937. *Sinumelon eupesum* Iredale, South. Austr. Nat., Vol. xviii., p. 45, pl. ii., fig. 1, September 30. Musgrave Ranges.
Central Australia (Musgrave Ranges).

SINUMELON EXPOSITUM Iredale, 1937.

1937. *Sinumelon expositum* Iredale, South Austr. Nat., Vol. xviii., p. 43, pl. ii., fig. 22, September 30. Charlotte Waters.
South Australia (Charlotte Waters).

SINUMELON FODINALE Bednall, 1892.

1892. *Helix (Hadra) fodinalis* Bednall Trans. Roy. Soc. South Austr., Vol. xvi., p. 63, pl. i., figs. 1a-c., December, ex Tate MS. Waukaringa, South Australia.
South Australia (Waukaringa district).

SINUMELON SERLENSE Iredale, 1937.

1937. *Sinumelon fodinale serlense* Iredale, South Austr. Nat., Vol. xviii., p. 43, pl. ii., fig. 12, September 30. Mount Serle.
South Australia (Mount Serle district).

Sinumelon subfodinale *sp. nov.*

(Plate xiii., fig. 7.)

Specimens from Silverton, Barrier Ranges, New South Wales, were so named by Tate many years ago. The shells resemble the true *fodinalis* in form and coloration, but are larger and have the umbilicus more hidden by the expansion of the columella. The coloration is pale fawn with a pale reddish band, but there is a fine granulation overrunning the coarse radial growth lines, which are however finer than in *fodinalis*. The type measures breadth, 20 mm.; height, 17 mm.

South Western New South Wales. North Western Victoria.

Sinumelon finitinum *sp. nov.*

(Plate xiii., fig. 6.)

Shell subglobose, pale greenish white with a pale rusty anteperipheral band, mouth white. Spire a little elevated, whorls rounded, columella reflected almost hiding the open umbilicus, outer lip thin, a little recurved. Sculpture consists of rather coarse, flattened growth lines, covered with a fine irregular granulation. Height, 22 mm.; breadth, 23 mm. Type from Broken Hill N.S.W.

Mid Western New South Wales (Broken Hill).

Sinumelon simulante *sp. nov.*

(Plate xiii., fig. 15.)

Larger than preceding, pale greenish with upper part of whorl brownish, spire more elevated and columellar appression almost closing umbilicus. The sculpture of fine flattened growth lines very rarely shows any granulation whatever. The type measures 26 mm. in breadth by 25 mm. in height. Many specimens collected by H. K. Bennett at Mossgiel and on the Lachlan River banks.

Mid Western New South Wales (Mossgiel).

Sinumelon marshalli *sp. nov.*

(Plate xiii., fig. 5.)

Shells collected by A. J. Marshall at Barcaldine, Mid West Queensland, are similar to *fodinalis,* but are larger and with a more elevated spire. They are white (dead), but show no granulation, but traces of a concentric lining. The type measures 19 mm. in breadth and 17 mm. in height. This is the first record of this group from Queensland, where it probably has a wide range.

Mid West Queensland (Barcaldine).

Sinumelon flindersi Angas, 1864.

1864. *Helix (Hadra) flindersi* Angas, Proc. Zool. Soc. (Lond.), 1863, p. 521, April 20, 1864, ex A. Adams & Angas MS. Tillowie, near western slopes of Flinders Range, South Australia. Figd. Cox, Mon. Austr. Land Shells, p. 51, pl. xx., fig. 11, May, 1868, from a painting of the type by Angas.

1868. *Helix bitaeniata* Cox, Mon. Austr. Land Shells, p. 50, pl. iv., fig. 9, May. Port Augusta, South Australia (Masters). Refigd. Angas, Proc. Zool. Soc. (Lond.), 1876, p. 268, pl. xx., figs. 15-16 (Masters).
South Australia.

SINUMELON PETUM Iredale, 1937.

1937. *Sinumelon petum* Iredale, South Austr. Nat., Vol. xviii., p. 44 pl. ii., fig. 14, September 30. Mount Yardea, Gawler Ranges.
South Australia (Gawler Ranges).

SINUMELON AVERSUM Iredale, 1937.

1937. *Sinumelon aversum* Iredale, South Austr. Nat., Vol. xviii., p. 44, pl. ii., fig. 15, September 30. Blinman, Flinders Range.
South Australia (Blinman district).

SINUMELON PERINFLATUM Pfeiffer, 1864.

1864. *Helix perinflata* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 528 April 20, 1864, ex Angas, p. 520, *nom nud.* MacDonnell Range, Central Australia (Waterhouse). Figd. Cox, Mon. Austr. Land Shells, p. 45, pl. xx., fig. 2, May, 1868, from a painting of the type by Angas.
Central Australia (MacDonnell Range).

SINUMELON IMPLETUM Iredale, 1937.

1937. *Sinumelon impletum* Iredale, South Austr. Nat., Vol. xviii., p. 44, pl. i., fig. 1, September 30. Birksgate Ranges.
Central Australia (Birksgate Ranges).

SINUMELON PEDASUM Iredale, 1937.

1937. *Sinumelon pedasum* Iredale, South Austr. Nat., Vol. xviii., p. 44, pl. ii., fig. 2, September 30. Musgrave Ranges.
Central Australia (Musgrave Ranges).

SINUMELON REMISSUM Iredale, 1937.

1937. *Sinumelon remissum* Iredale, South Austr. Nat., Vol. xviii., p. 45, pl. ii., fig. 4, September 30. Wilson, east Flinders Range.
South Australia (Wilson district).

SINUMELON CORINUM Iredale, 1937.

1937. *Sinumelon corinum* Iredale, South Austr., Nat. Vol. xviii., p. 46, pl. ii., fig. 5, September 30. Everard Ranges. Figd. Bednall, Trans. Roy. Soc. South Austr., Vol. xvi., p. 62, pl. i., fig. 6, December, 1892.
Central Australia (Everard Ranges).

SINUMELON PUMILIO Iredale, 1937.

1937. *Sinumelon pumilio* Iredale, South Austr., Nat. Vol. xviii., p. 45, pl. ii., fig. 11, September 30. Everard Ranges.
Central Australia (Everard Ranges).

Genus GRANULOMELON Iredale, 1933.

1933. *Granulomelon* Iredale, Rec. Austr. Mus., Vol xix., p. 51, August 2. Orthotype, *Hadra grandituberculata* Tate.

GRANULOMELON GRANDITUBERCULATUM Tate, 1894.

1894. *Hadra grandituberculata* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 193, November. Central Australia = Maude River, Hart Range. Figd. Rep. Horn. sci. Exped. Cent. Austr., pl. ii., Zool., p. 200, pl. xviii., fig. 11, February, 1896.
Central Australia (Hart Ranges).

Genus BASEDOWENA Iredale, 1937.

1937. *Basedowena* Iredale South Austr. Nat., Vol. xviii., p. 51, September 30. Orthotype, *B. cottoni* Iredale.

BASEDOWENA COTTONI Iredale, 1937.

1937. *Basedowena cottoni* Iredale, South Austr. Nat., Vol. xviii., p. 51, pl. ii., fig. 24, September 30. Musgrave Ranges, Central Australia (H. Basedow).
Central Australia (Musgrave Ranges).

Genus PLEUROXIA Ancey, 1887.

1887. *Pleuroxia* Ancey, Conch. Exchange, Vol. ii., pt. 3, p. 38, September. New name for.

1864. *Angasella* Angas, Proc. Zool. Soc. (London), 1863, p. 521 April 20, 1864, ex A. Adams MS. Haplotype, *Helix cyrtopleura* Pfeiffer.
Not *Angasiella* Crosse, Journ. de Conch., Vol. xii., p. 50, footnote, January 1, 1864.

PLEUROXIA CYRTOPLEURA Pfeiffer, 1862.

1862. *Helix cyrtopleura* Pfeiffer, Journ. de Conch., Vol. x., p. 227, pl. x., fig. 4, July 1. Near Lake Torrens, South Australia (probably Arrowie).
South Australia.

PLEUROXIA PHILLIPSIANA Angas, 1873.

1873. *Helix (Angasella) phillipsiana* Angas, Proc. Zool. Soc. (Lond.), 1873, p. 183, pl. xx., fig. 4, June. Arrowie, interior of South Australia.
South Australia.

PLEUROXIA MAWSONI Iredale, 1937.

1937. *Pleuroxia mawsoni* Iredale, South Austr. Nat., Vol. xviii., p. 48, pl. ii., fig. 17, September 30. Grampus Range, South Australia.
South Australia (Grampus Range).

PLEUROXIA POLYPLEURA Tate, 1899.

1899. *Angasella polypleura* Tate, Trans. Roy. Soc. South Austr., Vol xxiii., p. 246, pl. vi., figs. 2a-c., December. Bunda Plateau, Great Australian Bight, South Australia.
South Australia (western limit). South West Australia (eastern limit).

PLEUROXIA ARCIGERENS Tate, 1894.

1894. *Hadra arcigerens,* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 193, November. Central Australia. Figd. Rep. Horn. Sci. Exped. Cent. Austr., pt. ii. Zool., p. 192, pl. xix., fig. 27, February, 1896. Finke River Escarpment.
Central Australia (Finke River district).

PLEUROXIA OLIGOPLEURA Tate, 1894.

1894. *Hadra oligopleura* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 193, November. Eyre's Sand Patch, 160 miles west from Eucla, West Australia (Adcock). Figd. Rep. Horn. Sci. Exped. Cent. Austr., pt. ii., Zool., p. 21, pl. xix., fig. 39, February, 1896. "Flinders Range, South Australia". Error only from interchange of localities with *H. wilpenensis.*
South West Australia (eastern limits). South Australia (western limit).

PLEUROXIA RADIATA Hedley, 1905.

1905. *Xanthomelon radiatum* Hedley, Trans. Roy. Soc. South Austr., Vol. xxix., p. 163, pl. xxx., figs. 4-5-6, December. Mount Davies, Tomkinson Ranges.
Central Australia.

PLEUROXIA LEMANI Gude, 1916.

1916. *Angasella lemani* Gude, Proc. Mal. Soc. (Lond.), Vol. xii., p. 41, fig. in text, March 20. Cape Borda, Kangaroo Island.
South Australia (Kangaroo Island).

PLEUROXIA ADCOCKIANA Bednall, 1894.

1894. *Hadra adcockiana* Bednall, Trans. Roy. Soc. South Austr., Vol. xviii., p. 190, fig. in text November. Tempe Downs Station, Central Australia.
Central Australia.

PLEUROXIA TRUCA Iredale, 1937.

1937. *Pleuroxia truca* Iredale, South Austr., Nat., Vol. xviii., p. 49, pl. ii., fig. 8, September 30. Krickaueff Range.
Central Australia (Krickaueff Range).

PLEUROXIA EVERARDENSIS Bednall, 1892.

1892. *Helix (Hadra) everardensis* Bednall, Trans. Roy. Soc. South Austr., Vol. xvi., p. 64, pl. i., figs. 3a-c, December. Everard Range, 2,000 feet, Central Australia.
Central Australia (Everard Range).

PLEUROXIA GASCOYNENSIS Smith, 1894.

1894. *Helix (Trachia) gascoynensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 93, pl. vii., figs. 13, June. Gascoyne district, West Australia.
Western Australia (Gascoyne district).

Genus BACCALENA Iredale, 1937.

1937. *Baccalena* Iredale, South Austr. Nat., Vol. xviii., p. 50, September 30. Haplotype, *Hadra squamulosa* Tate.

BACCALENA SQUAMULOSA Tate, 1894.

1894. *Hadra squamulosa* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 193, November. Central Australia. Figd. Rep. Horn. Sci. Exped. Cent. Austr., pt. ii., Zool., p. 193, pl. xviii., fig. 10, February, 1896 (Palm Creek, Krickaueff Range).
1896. (*Chloritis*) *ophioderma* Tate, Rep. Horn. Sci. Exped. Cent Austr., pt. ii., Zool., p. 194, February. New name only.
Central Australia (Krickaueff Range).

Genus FATULABIA Iredale, 1937.

1937. *Fatulabia* Iredale, South Austr. Nat., Vol. xviii., p. 51, September 30. Haplotype, *Helix elderi* Bednall.

FATULABIA ELDERI Bednall, 1892.

1892. *Helix (Hadra) elderi* Bednall, Trans. Roy. Soc. South Austr., Vol. xvi., p. 64, pl. i., figs. 2a-c, 4-5, December. Birksgate Range, Central Australia.
Central Australia (Birksgate Range).

FATULABIA MUSGA Iredale, 1937.

1937. *Pleuroxia musga* Iredale, South Austr. Nat., Vol. xviii., p. 50, pl. ii., fig. 3, September 30. Musgrave Ranges, Central Australia.
Central Australia (Musgrave Ranges).

FATULABIA WILPENENSIS Tate, 1894.

1894. *Hadra wilpenensis* Tate, Trans. Roy. Soc. South Austr., Vol. xviii., p. 193, November. "Central Australia".

1896. *Thersites wilpenensis,* Tate, Rep. Horn. Sci. Exped., Cent. Austr., pt. ii., Zool., p. 219 (no text), pl. xix., fig. 28, February. "Eyre's Sand Patch, Western Australia". Error through interchange of localities with *A. oligopleura*, "Flinders Range, South Australia", i.e.: Six miles east of Wilpena Pound, South Australia (Tomsett).
South Australia (Wilpena Pound district).

FATULABIA HINSBYI Gude, 1916.

1916. *Angasella hinsbyi* Gude, Proc. Mal. Soc. (Lond.), Vol. xii., p. 42, fig. in text, March 20, ex Brazier MS. Mitchell district, Silvertown, New South Wales.
New South Wales (Broken Hill). (South Australia).

Genus GLYPTORHAGADA Pilsbry, 1890.

1890. *Glyptorhagada* Pilsbry, Man. Conch. (Tryon), Ser. 2, Vol. vi., p. 191, December 16. Logotype, Pilsby, *ibid.*, Vol. ix., p. 129 1892, *Helix silveri* Angas.

1933. *Eximiorhagada* Iredale, Rec. Austr. Mus. Vol. xix., p. 51, August 2. Orthotype, *Xanthomelon asperrimum* Hedley.

1933. *Halmatorhagada* Iredale, Rec. Austr. Mus., Vol. xix., p. 51, August 2. Orthotype, *Helix bordaensis* Angas.

GLYPTORHAGADA CLYDONIGERA Tate, 1894.

1894. *Hadra clydonigera* Tate, Trans. Roy. Soc. South Austr., Vol xviii., p. 193, November, Central Australia. Figd. Rep. Horn. Sci. Exped. Cent. Austr., pt. ii., Zool., p. 195, pl. xix. figs 2-4, February, 1896. MacDonnell Ranges.
Central Australia (MacDonnell Ranges).

GLYPTORHAGADA HERBERTI Iredale, 1937.

1937. *Glyptorhagada herberti* Iredale, South Austr., Nat., Vol. xviii., p. 53, pl. ii., figs. 19, September 30. Musgrave Ranges, Central Australia.

1905. *Xanthomelon clydonigerum* var., Hedley, Trans. Roy. Soc. South Austr., Vol. xxix., p. 162, pl. xxx., figs. 10, 11, 12, December.
Central Australia (Musgrave Ranges).

GLYPTORHAGADA SILVERI Angas, 1868.

1868. *Helix (Rhagada) silveri* Angas, Proc. Zool. Soc (Lond.), 1868, p. 257, text in figs., September 15. Eastern Plains, South Australia (S. W. Silver).
South Australia (Eastern Plains).

GLYPTORHAGADA KOORINGENSIS Angas, 1877.

1877. *Helix (Rhagada) kooringensis* Angas, Proc. Zool. Soc. (Lond.), 1877, p. 33, fig. in text, June 1. 30 miles N.E. from Burra Mines, South Australia (F. G. Waterhouse).
South Australia (Kooringa district).

GLYPTORHAGADA PECUNIOSA Iredale, 1937.

1937. *Glyptorhagada pecuniosa* Iredale, South Austr. Nat., Vol. xviii., p. 54, pl. ii., fig. 10, September 30. Mannahill, north from Kooringa, South

Australia. Figd. Cox, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. ii., p. 1062, 1887 (animal).
South Australia (range north of the preceding).

GLYPTORHAGADA ASPERRIMA Hedley, 1905.

1905. *Xanthomelon asperrimum* Hedley, Trans. Roy. Soc. South Austr., Vol. xxix., p. 164, 3 text figs., December. Mann Ranges, Central Australia.
Central Australia (Mann Ranges).

GLYPTORHAGADA EUGLYPTA Tate, 1899.

1899. *Glyptorhagada euglypta* Tate, Trans. Roy. Soc. South Austr., Vol. xxiii., p. 245, pl. vi., figs. 3a-c., December. Anabama, 100 miles N.E. from Burra Burra, S.A. (Brown).
South Australia (Anabama district).

GLYPTORHAGADA BORDAENSIS Angas, 1880.

1880. *Helix bordaensis* Angas, Proc. Zool. Soc. (Lond.), 1880, p. 419, pl. xl., fig. 3, October 1. Kangaroo Is., South Australia.
South Australia (Kangaroo Island).

Genus DIVELLOMELON Iredale, 1933.

1933. *Divellomelon* Iredale Rec. Austr. Mus., Vol. xix., p. 51, August 2. Orthotype, *Thersites hillieri* Smith.

DIVELLOMELON HILLIERI Smith, 1910.

1910. *Thersites hillieri* Smith, Proc. Malac. Soc. (Lond.), Vol. ix., p. 26, fig. in text, March 31. Hermannsburg, South Central Australia.
Central Australia.

Genus BAUDINELLA Thiele, 1931.

1931. *Baudinella* Thiele, Handbuch syst. Weicht., Vol. i., p. 685. Orthotype, *Helix baudinensis* Smith.

1933. *Gonobaudinia* Iredale, Rec. Austr. Mus., Vol. xix., p. 55. August 2. Orthotype, *Helix baudinensis* Smith.

BAUDINELLA BAUDINENSIS Smith, 1893.

1893. *Helix (Gonostoma) baudinensis* Smith, The Conchologist, Vol. ii., p. 97, fig. in text, March 25. Baudin Is., North West Australia (J. J. Walker).
North West Australia (Baudin Island).

Genus SETOBAUDINIA Iredale, 1933.

1933. *Setobaudinia* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Helix collingii* Smith.

SETOBAUDINIA COLLINGII Smith, 1893.

1893. *Helix (Gonostoma) collingii* Smith, The Conchologist, Vol. ii., p. 98, fig. in text, March 25. Baudin Is., North West Australia (J. J. Walker).
North West Australia (Baudin Island).

Genus CRISTIGIBBA Tapparone-Canefri, 1883.

1883. *Cristigibba* Tapparone-Canefri, Ann. Mus. Civ. Genova, Vol. xix., pp. 161-171, July 5. Orthotype, *Helix tortilabia* Lesson.

1933. *Australgibba* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Helix wesselensis* Cox.

CRISTIGIBBA (AUSTRALGIBBA) WESSELENSIS Cox, 1868.

1868. *Helix wesselensis* Cox, Mon. Austr. Land Shells, p. 110, pl. xix., figs. 4a-b., May. Wessel Is., North Coast of Australia (J. M. Creed).
Northern Territory (Wessel Island).

Genus ARNEMELASSA Iredale, 1933.

1933. *Arnemelassa* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Helix creedi* Cox.

ARNEMELASSA CREEDI Cox, 1868.

1868. *Helix creedi* Cox, Mon. Austr. Land Shells p 110, pl. xix., figs. 2-2a, May. Cadell's Straits, North Coast Australia (J. M. Creed).
Northern Territory.

Genus TORRESITRACHIA Iredale, 1933.

1933. *Torresitrachia* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Helix endeavourensis* Brazier.

TORRESITRACHIA TORRESIANA Hombron & Jacquinot, 1814.

1841. *Helyx torresiana* Hombron & Jacquinot, Ann. Sci. Nat. (Paris), Ser. 2, Vol. xvi., p. 63, July. Ile Toud, Torres Strait. Figd. Voy. au Pôle Sud., Atlas, Moll., pl. 4, figs. 24-27, 1851; Vol. v., p. 10, 1854.

1842. *Helix delessertiana* Le Guillou, Revue Zool. Soc. Cuv., 1842, p. 138, Mai no = June. Ile Warrior, Torres Strait.

1846. *Helix taranaki* Pfeiffer, Symb. hist. Helic., Vol iii., p. 74, ex Gray MS. "New Zealand error = Possession Is., Torres Strait. *Fide* Reeve, Conch. Icon., Vol. vii., pl. 83, sp. 443, 1852, who also cited Gray, N.Z., App., pl. i., figs. 6-7, which was never issued.

1851. *Helix torresii* Forbes, Narr. Voy. Rattlesnake (MacGillivray), Vol. ii., p. 370, as of "H. & J. Atlas", in synonymy.

1867. *Helix leucolena* Crosse, Journ. de Conch., Vol. xv., p. 447, October 1; *id.*, Vol. xvi., p. 171, pl. vi., fig. 6, April, 1868 "Vanuea Levi, Fiji". Error = North Queensland, Cf. Ancey, Journ. de Conch., Vol. lii., p. 296, December 25, 1904.

1872. *Helix* (*Trachia*) *endeavourensis* Brazier, Proc. Zool. Soc. (Lond.), 1871, p. 640, May 2, 1872. Endeavour River, North Coast.
North Queensland.

Note.—*Helix* (*Trachia*) *dentoni* Ford, Nautilus, Vol. iii., p. 17, fig. in text, June, described as from New Guinea, collected by W. Denton, is supposed to be referable to this species, and not from New Guinea.

TORRESITRACHIA STIPATA *sp. nov.*

(Plate xii., fig. 27.)

Shells from the Sir Edward Pellew Group in the Gulf of Carpentaria collected by Dr. W. E. J. Paradice are very like *torresiana*, but are more compressed, umbilicus wider, the sculpture stronger and more regular, more marked on the base, the mouth shallower and smaller. The type measures 19 mm. in breadth and 10 mm. in height.

Northern Territory (Sir Edward Pellew Group).

TORRESITRACHIA BATHURSTENSIS Smith, 1894.

1894. *Helix* (*Trachia*) *bathurstensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 93, pl. vii., fig. 20, June. Heywood Is. and Bathurst Is., King Sound, North West Australia.
North West Australia.

TORRESITRACHIA ACUTICOSTATA Fulton, 1907.

1907. *Planispira* (*Trachiopsis*) *acuticostata* Fulton, Proc. Malac. Soc. (Lond.), Vol. vii., p. 362 fig. in text, September. Dalrymple, Queensland.
North Queensland (South of Townsville).

TORRESITRACHIA GLOMERANS *sp. nov.*

(Plate xiii., fig. 12.)

About Chillagoe, North Queensland, Mr. W. D. Campbell collected numbers of globose shells varying in height and with the base sculptured. The shell is subglobose, spire short, elevated narrowly but openly umbilicated, the mouth large, the outer lip reflected, the columella triangularly reflected but not concealing the umbilicus. The sculpture consists of slanting ribs, very regular and closely packed and these continue strongly on to the base. Colour of dead shell white, living translucent. Height, 22 mm.; breadth, 28 mm.

North Queensland (Chillagoe district).

The globose form suggests separation, and therefore a new subgeneric name *Melostrachia* is introduced with this species as type.

Genus TROZENA *nov.*

Type, *T. morata sp. nov.*

Related to *Trachiopsis* but larger and acutely peripherally keeled; the umbilicus wider, the mouth comparatively smaller, sculpture similar, but apex of 1½ whorls regularly coarsely granulose.

TROZENA MORATA *sp. nov.*

(Plate xii., fig. 18.)

Shell flattened, spire little elevated, whorls four succeeding apex; sculpture coarse radials irregularly sparsely grained, grains more numerous on base where radials are finer. Breadth of type from Chillagoe, 11 mm.; height, 5 mm.

North Queensland (Chillagoe district).

Genus TRACHIOPSIS Pilsbry, 1893.

1893. *Trachiopsis* Pilsbry, Man. Conch (Tryon), Ser. 2, Vol. viii., p. 284, July 1. Orthotype, *Helix tuckeri* Pfeiffer.

TRACHIOPSIS TUCKERI Pfeiffer, 1846.

1846. *Helix tuckeri* Pfeiffer, Symb. hist. Helic., Vol. iii., p. 77. Sir Charles Hardy's Is. (Queensland), (B. W. Tucker). Figd. Syst. Conch. Cab. (Mart & Chemn), ed. Kuster, pl. 79, figs. 10-12, 1851. Reeve, Conch. Icon., Vol. vii., pl. cxi., fig. 633, August, 1852
North Queensland.

TRACHIOPSIS STRANGULATA Hombron & Jacquinot, 1841.

1841. *Helyx strangulata* Hombron & Jacquinot, Ann. Sci. Nat. (Paris), Ser. 2, Vol. xvi., p. 64, July. Ile Toud, Torres Strait. Figd. Voy. av. Pôle Sud., Atlas, Moll., pl. 6, figs. 1-4, 1851.

1842. *Helix cyclostomata* Le Guillou, Rev. Zool. Soc. Cuv. 1842, p. 141, Mai no = June. L'île Warrior, Torres Strait. Figd. Cox, Mon. Austr. Land Shells, p. 61, pl. x., fig. 12, May, 1868.
North Queensland (Islands in Torres Strait).

TRACHIOPSIS TRUCULENTA Hedley, 1912.

1912. *Planispira truculenta* Hedley, Rec. Austr. Mus., Vol. viii., p. 156, May 6. New name for *P. tuckeri* as figured by Pilsbry, Man. Conch., Ser. 2, Vol. ix., pl. xix., figs. 18-19, 1894. Port Curtis, Queensland.
South Queensland (Port Curtis district).

TRACHIOPSIS MUCOSA Cox, 1868.

1868. *Helix mucosa* Cox, Proc. Zool. Soc. (Lond), 1867, p. 725, April 3, 1868. Mon. Austr. Land Shells, p. 19, pl. xi., fig. 14, May, 1868. Clarence River, N.S.W. (J. MacGillivray).
Northern New South Wales. South Queensland.

Note.—Apparently this group ranges from Torres Strait Islands down into Northern New South Wales, and there may be many more forms to be determined.

Family RHAGADIDAE.

This family is necessary for the reception for the curious North West Australian land shells. These have no close relation with other molluscan forms from East or South Australia; but apparently are closely related to East Indian species, suggesting an entry into Australia by means of the Timor Sea. They live in limestone districts and apparently many species and genera occur together, although there seem to be geographical series.

Genus RHAGADA Albers, 1861.

1861. *Rhagada* Albers, Die Heliceen, 2nd ed. (Martens), p. 108, "1860". Orthotype, *Helix reinga* Gray = *torulus* Férussac.

RHAGADA TORULUS Férussac, 1819.

1819. *Helix torulus* Férussac, Hist. Moll., liv. 6, pl. xxviii., figs. 3-4, November. Syst. Tabl. Hist. Moll., p. 34, January; p. 30, June, 1821. New Holland (Péron) = Shark's Bay, W.A.

1846. *Helix reinga* Pfeiffer, Symb. Helic., Vol. iii., p. 73, ex Gray MS. New Zealand, error = Shark's Bay, W.A. Figd. Reeve, Conch. Icon., Vol. vii., pl. 128, sp. 772, October, 1852.
West Australia (Shark's Bay district).

RHAGADA CONVICTA Cox, 1870.

1870. *Helix convicta* Cox, Proc. Zool. Soc. (Lond.), 1870, p. 171, pl. xvi., fig. 6, November 11. Nichol Bay, West Australia.
West Australia (Nichol Bay).

RHAGADA ELACHYSTOMA Martens, 1877.

1877. *Helix elachystoma* Martens, Monatsb. Ak. Berlin, 1877, p. 273, pl. i., figs. 8-9. Mermaid Strait, North West Australia (T. Studer).
West Australia (Mermaid Strait district).

RHAGADA RICHARDSONII Smith, 1874.

1874. *Helix richardsonii* Smith, Zool. Voy. Erebus and Terror, Moll., p. 2, pl. 4, fig. 14. Dupuch's Is., West Australia. (Stokes per Richardson. Collected by Dring.)
West Australia (Dupuch's Island).

RHAGADA RADLEYI Preston, 1908.

1908. *Rhagada radleyi* Preston, Proc. Malac. Soc. (Lond.), Vol. viii., p. 120, text fig., July 20. Western Australia.
West Australia.

RHAGADA TESCORUM Benson, 1853.

1853. *Helix tescorum* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. vi., p. 30, January 1. Shark's Bay, West Australia. Figd. Reeve, Conch. Icon., Vol. vii., p. 171, sp. 1154, October, 1853.
West Australia (Shark's Bay district).

RHAGADA OSCARENSIS Cox, 1892.

1892. *Helix (Hadra) oscarensis* Cox, Proc. Linn. Soc. N.S.W., Vol. vi., p. 565, pl. xx., figs. 6-7, May 23. Oscar Ranges, 20 milês from Derby, N.W.A. (Coll. W. W. Froggatt.).

1894. *Helix (Rhagada) inconvicta* Smith, Proc. Malac. Soc. (Lond.), Vol. i., p. 90, pl. vii., fig. 10, June. Oscar Ranges, 120 miles S.E. of King Sound, N.W.A.
North West Australia (Oscar Ranges).

Genus PLECTORHAGADA Iredale, 1933.

1933. *Plectorhagada* Iredale, Rec. Austr., Mus., Vol. xix., p. 52, August 2. Orthotype, *Helix plectilis* Benson.

PLECTORHAGADA PLECTILIS Benson, 1853.

1853. *Helix plectilis* Benson, Ann. Mag. Nat. Hist., Ser. ii., Vol. xi., p. 29, January 1. Shark's Bay, West Australia. Figd. Reeve, Conch. Icon., Vol. vii., pl. 172, sp. 1162, October, 1853. Cox, Mon. Austr. Land Shells, p. 44, pl. xx., fig. 8, May, 1868, from a painting of the type by Angas.

1854. *Helix paleata* Reeve, Conch. Icon., Vol. vii., pl. 199, sp. 1399, December. "Banks of the Swan River, Australia, (Bacon"). Error = Shark's Bay, Western Australia.

1864. *Helix carcharias* Pfeiffer, Proc. Zool. Soc. (Lond.), 1863, p. 528, April 20, 1864. Shark's Bay, Western Australia. Figd. Cox, Mon. Austr. Land Shells, p. 45, pl. xx., fig. 12, May 1, 1868 from a painting of the type by Angas.
West Australia (Shark's Bay).

Genus AMPLIRHAGADA Iredale, 1933.

1933. *Amplirhagada* Iredale, Rec. Austr. Mus., Vol. xix., p. 52, August 2. Orthotype, *Helix sykesi* Smith.

AMPLIRHAGADA SYKESI Smith, 1894.

1894. *Helix (Hadra) sykesi* Smith Proc. Mal. Soc. (Lond.), Vol. i., p. 92, pl. vii., fig. 8, June. Parry Island, Admiralty Gulf.
North West Australia (Parry Island).

AMPLIRHAGADA MONTALIVETENSIS Smith, 1894.

1894. *Helix (Hadra) montalivetensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 91, pl. vii., fig. 21, June. Montalivet Island.
North West Australia (Montalivet Island).

AMPLIRHAGADA COMBEANA *nom. nov.*

1894. *Helix (Hadra) imitata* var. *cassiniensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 92, pl. vii., fig. 16, June. Cassini Island, North West Australia. Not *Helix millepunctata* var. *cassiniensis* Smith, *l.c.*
North West Australia (Cassini Island).

AMPLIRHAGADA IMITATA Smith, 1894.

1894. *Helix (Hadra) imitata* Smith Proc. Mal. Soc. (Lond.), Vol. i., p. 92,

pl. vii., fig. 15, June. Baudin Island.
North West Australia (Baudin Island).

AMPLIRHAGADA BURNERENSIS Smith, 1894.

1894. *Helix* (*Hadra*) *burnerensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 91, pl. vii., fig. 18, June. Burner (error for Barrier) Ranges, Derby district, North West Australia.
North West Australia (Barrier Ranges).

Genus PARRHAGADA *nov.*

Type, *Thersites woodwardi* Fulton.

Large Rhagadoid shells of depressed form, imperforate or perforate, but with the outer lip expanded giving it a flaring appearance.

PARRHAGADA WOODWARDI Fulton, 1902.

1902. *Thersites* (*Rhagada*) *woodwardi* Fulton, Proc. Mal. Soc. (Lond.), Vol. v., p. 33, fig. in text., April. North West Australia (B. H. Woodward).
North West Australia.

Genus GLOBORHAGADA Iredale, 1933.

1933. *Globorhagada* Iredale, Rec. Austr. Mus., Vol. xix., p. 52, August 2. Orthotype, *Helix prudhoensis* Smith.

GLOBORHAGADA PRUDHOENSIS Smith, 1894.

1894. *Helix* (*Hadra*) *prudhoensis* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 91, pl. vii., fig. 9, June. Prudhoe Island, North West Australia (Lieut. J. W. Combe, H.M.S. Penguin).
North West Australia (Prudhoe Island).

GLOBORHAGADA LEPTOGRAMMA Pfeiffer, 1846.

1846. *Helix leptogramma* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 127, February, 1846. Cygnet Bay, North Australia (Ince). Figd. Reeve, Conch. Icon., Vol. vii., pl. 82, sp. 437, March 1852. Copied Cox, Mon. Austr. Land Shells p. 41, pl. x., fig. 4, May, 1868.
North West Australia (Derby district).

GLOBORHAGADA MONTEBELLOENSIS Preston, 1914.

1914. *Rhagada montebelloensis* Preston, Proc. Mal. Soc. (Lond.), Vol. xi., p. 13, fig. in text., March 30. Montebello Island.
North West Australia (Montebello Island).

GLOBORHAGADA OBLIQUIRUGOSA Smith, 1894.

1894. *Helix* (*Hadra*) *obliquirugosa* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 90, pl. vii., fig. 17, June. Parry Harbour, North West Australia.
North West Australia (Parry Harbour).

Genus BELLRHAGADA *nov.*

Type, *Rhagada plicata* Preston.

The little species named *plicata* Preston is unlike any other West Australian shell, somewhat globose, imperforate (or perforate) sutures almost canaliculate, mouth subcircular, lip little expanded; apical whorls large and smooth, upper part of later whorls radially sculptured, the sculpture much weaker on the base.

BELLRHAGADA PLICATA Preston, 1914.

1914. *Rhagada plicata* Preston, Proc. Mal. Soc. (Lond.), Vol. xi., p. 13, fig. in text, March 30. Montebello Island.
North West Australia (Montebello Island).

[HELIX DRINGI Pfeiffer, 1846.

1846. *Helix dringi* Pfeiffer, Symb. Helic., Vol. iii., p. 73. East Australia. Figd. Reeve, Conch. Icon., Vol. vii., pl. 28, sp. 769, October, 1852.

This species from "near Torres Strait, collected by Dring", looks like a *Torresitrachia,* but is imperforate suggesting a Rhagadoid affinity. Dring collected mostly on the West Coast. The type is unique.]

Genus WESTRALTRACHIA Iredale, 1933.

1933. *Westraltrachia* Iredale, Rec. Austr. Mus., Vol. xix., p. 55, August 2. Orthotype, *Trachia froggatti* Ancey.

WESTRALTRACHIA FROGGATTI Ancey, 1898.

1898. *Trachia froggatti* Ancey, Proc. Linn. Soc. N.S.W., Vol., xxii., p. 774, pl. xxxvi., fig. 2, June 4. Oscar Range 100 miles inland from Derby, North West Australia (W. W. Froggatt).
North West Australia.

WESTRALTRACHIA MONOGRAMMA Ancey, 1898.

1898. *Trachia monogramma* Ancey, Proc. Linn. Soc. N.S.W., Vol. xxii., p. 775, pl. xxxvi., fig. 3, June 4. Oscar Range, North West Australia (W. W. Froggatt).
North West Australia.

WESTRALTRACHIA DERBYI Cox, 1892.

1892. *Helix (Hadra) derbyi* Cox, Proc. Linn. Soc. N.S.W., Ser. 2, Vol. vi., p. 566, pl. xx., figs. 4-5 May 23. Derby district, North West Australia (W. W. Froggatt).

1894. *Helix (Trachia) derbyana* Smith, Proc. Mal. Soc. (Lond.), Vol. i., p. 92, pl. vii., fig. 19, June. Burner = Barrier Ranges, Derby, North West Australia.
North West Australia.

WESTRALTRACHIA ORTHOCHEILA Ancey, 1898.

1898. *Trachia orthocheila* Ancey, Proc. Linn. Soc. N.S.W., Vol. xxii., p. 774, pl. xxxvi., fig. 4, June 4. Oscar Range 100 miles inland from Derby, North West Australia (W. W. Froggatt).
North West Australia.

Note.—It will be noted that all the species of *Westraltrachia* were collected by W. W. Froggatt, and while the first named is very distinct the others are not so easily separable from each other.

Super Family PARYPHANTOIDEA

The Austral-Neozelanic carnivorous snails are here classed together under the above heading. Thiele (Handb. syst. Weicht, Teil 2, p. 722, 1931) introduced a Stirps Streptaxacea, which is one of his many artificial groups, its contents being the families Hapeotrematidae, Paryphantidae, Aperidae and Streptaxidae. These families have no close relationship whatever as any one conversant with these snails in nature will admit. Therefore the correct nomination will depend on the use the earliest Austral Neozelanic name as basis for a super family name as obviously there is more than one family in Australia alone.

Family PARYPHANTIDAE

This Neozelanic family appears to be represented in Australia by *Victaphanta* and its allies. Mr. A. W. B. Powell has told me that the anatomy of the Victorian species is very similar to that of the Neozelanic forms. The Rhytidoid species appear to deserve separation, as undoubtedly they con-

stitute a distinct series in Australia. Large and small species range from Tasmania to Cape York, none of which shows any Paryphantoid facies.

Genus VICTAPHANTA Iredale, 1933.

1933. *Victaphanta* Iredale, Rec. Austr. Mus., Vol. xix., p. 40, August 2. Orthotype, *Nanina atramentaria* Shuttleworth.

VICTAPHANTA ATRAMENTARIA Shuttleworth, 1853.

1853. *Nanina atramentaria* Shuttleworth, Mitth. Nat. Gesell. Berne, 1852, p. 194, Port Phillip, Victoria. Figd. Cox, Mon. Austr. Land Shells, p. 5, pl. iii., fig. 2, May, 1868. Figd. Not. Malac. (Shuttleworth), heft. ii., ed. Fischer, Paryphanta, p. 5, pl. i. fig. 2, 1877.
Victoria.

VICTAPHANTA COMPACTA Cox & Hedley, 1912.

1912. *Paryphanta compacta* Cox & Hedley, Mem. Nat. Mus., Melb., No. 4, 8, pl. i., figs. 3-5 February. Otway Ranges, Victoria.
Victoria (Otway Ranges).

Genus MELAVITRINA Iredale, 1933.

1933. *Melavitrina* Iredale, Rec. Austr., Mus., Vol. xix.. p. 40, August 2. Orthotype, *Vitrina milligani* Pfeiffer.

MELAVITRINA MILLIGANI Pfeiffer, 1854.

1854. *Vitrina milligani* Pfeiffer, Proc. Zool. Soc. (Lond.), 1852, p. 56, March 22, 1854. Macquarie Harbour, Tasmania. Figd. Cox, Mon. Austr. Land Shells, p. 82, pl. xiv., figs. 2-2a, May, 1868.
Tasmania (West Coast).

MELAVITRINA FUMOSA Tenison-Woods, 1878.

1878. *Helicarion fumosa* Tenison-Woods, Proc. Linn. Soc. N.S.W., Vol. ii., p. 124, pl. xii., figs. 3-3a, December. Tasmania = Duck River, North East Coast (Petterd).
Tasmania (North East Coast).

Genus PROLESOPHANTA Iredale, 1933.

1933. *Prolesophanta* Iredale, Rec. Austr. Mus., Vol. xix., p. 40, August 2. Orthotype, *Helix dyeri* Petterd.

PROLESOPHANTA DYERI Petterd, 1879.

1879. *Helix dyeri* Petterd, Mon. Land Shells Tasm., p. 40, April. Launceston, Tasmania Figd. Hedley and Petterd, Rec. Austr. Mus., Vol. vii., p. 287, pl. 86, figs. 38-40, 1909.
Tasmania (North East). Victoria?

Genus SALADELOS Iredale, 1933.

1933. *Saladelos* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Orthotype, *Helix splendidula* Pfeiffer = *Saladelos commixta* Iredale.

SALADELOS COMMIXTA Iredale, 1933.

1933. *Saladelos commixta* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. New name for

1346. *Helix splendidula* Pfeiffer, Proc. Zool. Soc. (Lond.), 1845, p. 128, February, 1846. East Australia (Ince) = Islands in Torres Strait. Figd. Pfeiffer, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I. (2), figs. 1-3, 1851; Reeve, Conch. Icon., Vol. vii., *Helix*, pl. 150, sp. & fig. 973, February, 1853. Not *Helix splendidula* Gmelin, Syst. Nat., Vol. vi., p. 3655, 1791.
North Queensland (Islands in Torres Strait).

SALADELOS LACERTINA Iredale, 1933.
(Plate xii., fig. 17.)

1933. *Saladelos commixta lacertina* Iredale, Rec Austr. Mus., Vol. xix., p. 48, August 2. Lizard Is., N.Q. (Macgillivray).
North Queensland (Lizard Island).

SALADELOS BENSA Iredale, 1933.
(Plate xii., fig. 22.)

1933. *Saladelos commixta bensa* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Ben Lomond, Port Denison, Queensland.
Mid Queensland.

SALADELOS MACQUARIENSIS Cox, 1872.

1872. *Helix macquariensis* Cox, Proc. Zool. Soc. (Lond.), 1871, p. 645, pl. 52, fig. 7, May 2, 1872. Port Macquarie, N.S.W.
New South Wales.

SALADELOS ? URARENSIS Cox, 1866.

1866. *Helix urarensis* Cox, Journ. de Conch., Vol. xix., p. 46, January 1; Proc. Zool. Soc. (Lond.), 1865, p. 696, April 24, 1866; Urara, Clarence River, N.S.W. (Macgillivray).
New South Wales (Clarence River).

Note.—There has been no reference to this shell since its description.

SALADELOS HOBSONI Brazier, 1876.
(Plate xii., fig. 19.)

1876. *Helix (Rhytida) hobsoni* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 99, July. Palm Island, North Queensland.
North Queensland (Palm Island).

SALADELOS HELMSIANA *sp. nov.*
(Plate xii., fig. 23.)

More strongly sculptured with radials above, resembling a miniature *Strangesta*, but ribs more rude, the under surface smooth, the umbilicus rather narrow, the mouth wide and spreading, but not descending. Coloration pale honey, shell thin. Size of type, breadth, 6 mm.; height, 3 mm., from Wilson's Valley, Mount Kosciusko, 5,000 feet.

South New South Wales (Mount Kosciusko).

Genus ECHOTRIDA Iredale, 1933.

1933. *Echotrida* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Orthotype, *Helix strangeoides* Cox.

ECHOTRIDA STRANGEOIDES Cox, 1864.

1864. *Helix strangeoides* Cox, Cat. Austr. Land Shells, p. 20. Moreton Bay, Queensland. (R. L. King). Figd. Mon. Austr. Land Shells, p. 27, pl. xvii., fig. 3, May, 1868.
South Queensland. North New South Wales.

Genus TASMAPHENA Iredale, 1933.

1933. *Tasmaphena* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Orthotype, *Helix sinclairi* Pfeiffer.

TASMAPHENA SINCLAIRI Pfeiffer, 1845.

1845. *Helix sinclairi* Pfeiffer, Zeitschr., für. Malak., Vol. ii., p. 154 November. Van Diemen's Land = Hobart, S. Tasmania. Figd. Reeve, Conch. Icon., Vol. vii., pl. 205, figs. 1444a-b., December, 1854.

1854. *Helix bombycina* Reeve, Conch. Icon., Vol. vii., pl. 188, sp. 1314, July, ex Pfeiffer MS. (Proc. Zool. Soc. (Lond.), 1854, p. 55, January 10, 1855). Van Diemen's Land = S. Tasmania.

1871. *Helix (Patula) dubitans* Legrand, Coll. Mon. Tasm. Land Shells, sp. 29, pl. ii., fig. 7, June, ex Cox MS. North West Bay, S.E. Tasmania.

1871. *Helix (Patula) vexanda* Legrand, Coll. Mon. Tasm. Land Shells, pt. 43, June, ex Cox MS. North West Bay, S.E. Tasmania.

1871. *Helix (Patula) margatensis* Legrand, Coll. Mon. Tasm. Land Shells, sp. 54, June, ex Cox MS. North West Bay, S.E. Tasmania.

1871. *Helix (Videna) quaestiosa* Legrand, Coll. Mon. Tasm. Land Shells sp. 59, June, ex Cox MS. Oatlands, S. Tasmania.
Tasmania.

Genus TASMADELOS *nov.*

Type, *Helix nelsonensis* Brazier.

This genus differs from *Prolesophanta* in its more depressed form and its umbilicus; from *Saladelos* in its smaller size and sculpture.

TASMADELOS NELSONENSIS Brazier, 1871.

1871. *Helix (Hyalina) nelsonensis* Brazier, Proc. Zool. Soc. (Lond.), 1870, p. 661, April 1, 1871. Mount Nelson, Tasmania.

1871. *Helix (Paryphanta) fulgetrum* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., No. 31, pl. i. fig. 11, June; 2nd ed., No. 31, September, ex Cox MS. Brown's River, Tasmania.
Tasmania.

Note.—The type locality is in South Tasmania and northern shells are larger, but with a narrower umbilicus; this may be named subspecifically *T. n. abitens subsp. nov.*, the type from Launceston measuring 4 mm. in breadth, and 2 mm. in height. (Pl. xii., fig. 21).

Genus STRANGESTA Iredale, 1933.

1933. *Strangesta* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Orthotype, *Helix leichardti* Cox.

STRANGESTA LEICHARDTI Cox, 1864.

1864. *Helix leichardti* Cox, Cat. Austr. Land Shells, p. 35, Australia (Leichhardt) = Port Denison district Queensland. Figd. Cox, Mon. Austr. Land Shells, p. 25, pl. v., fig. 1, May, 1868.
Mid Queensland (Port Denison district).

STRANGESTA PTYCHOMPHALA Reeve, 1852.

1852. *Helix ptychomphala* Reeve, Conch. Icon., Vol. vii., Helix, pl. 126, sp. 760, August, 1852, ex Pfeiffer MS. (Proc. Zool. Soc. (Lond.), 1851, pp. 98, 254, July 26, 1853). Port Essington. Error = Cape Upstart, Qld.

1855. *Helix confusa* Pfeiffer, Proc. Zool. Soc. (Lond.), 1855, p. 112, August 13, Cape Upstart, Queensland.
Mid Queensland (Cape Upstart district).

STRANGESTA SHERIDANI Brazier, 1875.

1875. *Helix (Rhytida) sheridani* Brazier, Proc. Zool. Soc. (Lond.), 1875, p. 33, pl. iv., fig. 77a., June 1. Cardwell, North Queensland.
North Queensland.

STRANGESTA CAPILLACEA Férussac, 1822.

1822. *Helix capillacea* Férussac, Hist. Moll. livr. 27, pl. 82, fig. 5, ex *Helix (Helicella) capillacea* Férussac, Tabl. Syst. Anim., Moll., p. 44, January; p. 40 June, 1821, *nom. nud.*, Port Jackson. New South Wales (Péron).

1849. *Helix strangei* Pfeiffer, Zeitsch. für Malak. Vol. v., June, 1848, p. 94, January, 1849; Proc. Zool. Soc. (Lond.), 1848, p. 108, April 25, 1849. Brisbane Water, New South Wales (Strange). Figd. Reeve, Conch. Icon., Vol. vii., Helix, pl. 79, sp. 416, March, 1852.

1884. *Amphidoxa lavinia* Hutton, Trans. New Zeal. Inst., Vol. xvi., 1883, p. 180, May, 1884. Palmerston, Wellington, New Zealand. Error = Sydney, New South Wales.
New South Wales (Sydney district, coastal).

STRANGESTA WALKERI Gray, 1834.

1834. *Zonites walkeri* Gray, Proc. Zool. Soc. (Lond.), 1834, p. 63, November 25, "70,000 paces from Fort Macquarie".
New South Wales (Hunter River district, inland).

STRANGESTA FRICATA Gould 1852.

1852. *Nanina fricata* Gould, United States Expl. Exped. (Wilkes), Vol. xii., p. 32; Atlas, pl. v., fig. 71, 1862. Illawarra, N.S.W.
New South Wales (Illawarra district).

STRANGESTA GLACIAMANS *sp. nov.*
(Plate xii., fig. 24.)

Related to *fricata* Gould, but with the sculpture less pronounced and the umbilicus wider. Breadth, 16 mm.; height, 9 mm. Wilson's Valley, 5,000 ft.

Southern New South Wales (Mount Kosciusko).

STRANGESTA GAWLERI Brazier, 1872.

1872. *Helix (Zonites) gawleri* Brazier, Proc. Zool. Soc. (Lond.), 1872, p. 618, November 3. Mount Lofty Ranges, South Australia. Figd. Kobelt, Syst. Conch. Cab. (Mart. & Chemn.), ed. Kuster, Bd. I., Abth. xii. B. Agnatha, p. 37, pl. 7, figs. 12-14 (dated 26/xii/1902). Figd. Cotton & Godfrey, South Austr. Nat., Vol. xiii., p. 176, pl. 3, fig. 20. August = September 30, 1932.
South Australia (Mount Lofty Ranges).

STRANGESTA TUMIDULA Iredale, 1937.

1937. *Strangesta tumidula* Iredale, South Austr. Nat., Vol. xviii., p. 55, pl. ii., fig. 7, September 30, ex Tate MS. Robe South Australia.
South Australia (South-east district). Victoria (South-west).

STRANGESTA HARRIETTAE Cox, 1868.

1868. *Helix harriettae* Cox, Mon. Austr. Land Shells, p. 29, pl. xviii., figs. 9-9a, May. Richmond River, N.S.W.
New South Wales (Richmond River district).

STRANGESTA MAXIMA Mousson, 1869.
(Plate xiii., fig. 17.)

1869. *Zonites strangei* var. *maxima* Mousson, Journ. de Conch., Vol. xvii., p. 56, January. Brisbane, Moreton Bay (Dietrich).
South Queensland.

STRANGESTA BULLACEA Reeve 1854.

1854. *Helix bullacea* Reeve, Conch. Icon., Vol. vii., pl. 186, sp. 1288, July, ex Pfeiffer MS. (Proc. Zool. Soc. (Lond.), 1854, p. 53, January 10, 1855). Moreton Bay, Queensland (Strange).
South Queensland.

STRANGESTA ASSIMILANS Cox, 1864.

1864. *Helix assimilans* Cox, Cat. Austr. Land Shells, Add. p. no 135; Proc. Zool. Soc. (Lond.), 1864, p. 595, April 24. Clarence River New South Wales (MacGillivray). Figd. Cox, Mon. Austr. Land Shells, p. 26, pl. iv., fig. 11, and pl. ii., fig. 10. May, 1868.

1885. *Helix assimilis* Tryon, Man. Conch., Ser. ii., Vol. i., p. 124, error only. New South Wales (Clarence River district).

STRANGESTA LAMPRA Reeve, 1854.

1854. *Helix lampra* Reeve, Conch. Icon. Vol. vii., *Helix,* pl. 186, sp. 1295, July, ex Pfeiffer MS. (Proc. Zool. Soc. (Lond.), 1854, p. 53, January 10, 1855). Launceston, Tasmania (R. C. Gunn).
North Tasmania.

STRANGESTA RUGA Legrand, 1871.

1871. *Helix (Videna) ruga* Legrand, Coll. Mon. Tasm. Land Shells, 1st ed., no 24, pl. i., fig. 5, June; 2nd ed., no 24, September, ex Cox MS. Mount Wellington, Tasmania.

1882. *Helix exoptata* Tate, Trans. Roy. Soc. South Austr., Vol. iv., p. 75, January. Dandenong and Cape Otway, Victoria, *nomen nudum.*

1912. *Helix exoptata* Cox & Hedley, Mem. Nat. Mus., Melb., No. 4, p. 7, February. As synonym of *H. ruga.*
Tasmania. Victoria.

STRANGESTA LAMPROIDES Cox, 1868.

1868. *Helix lamproides* Cox, Proc. Zool. Soc. (Lond.), 1867, p. 722, April 3, 1868. North West Coast, Tasmania. Figd. Cox, Mon. Austr. Land Shells, p. 28 pl. x., fig. 13, May, 1868.
North West Tasmania.

Genus OCCIRHENEA Iredale, 1933.

1933. *Occirhenea* Iredale, Rec. Austr. Mus., Vol. xix., p. 48, August 2. Orthotype, *Helix georgiana* Quoy & Gaimard.

OCCIRHENEA GEORGIANA Quoy & Gaimard, 1832.

1832. *Helix georgiana* Quoy & Gaimard, Voy. Astrol. Zool., Vol. ii., p. 129, pl. x., figs. 26-30. King George's Sound South West Australia.
South Western Australia.

Genus MURPHITELLA Iredale, 1933.

1933. *Murphitella* Iredale, Rec. Austr. Mus., Vol. xix., p. 49, August 2. Orthotype, *Helix franklandiensis* Forbes.

MURPHITELLA FRANKLANDIENSIS Forbes, 1851.

1851. *Helix franklandiensis* Forbes, Narr. Voy. Rattlesnake (MacGillivray), Vol. ii. p. 379, pl. ii., figs. 2a-b., "1852" = mid December, 1851. Frankland Islands, North Queensland.

1876. *Helix (Rhytida) jamesi* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 99, July. Palm Island, North Queensland.
North Queensland (Palm. Is. to Frankland Islands).

MURPHITELLA FROGGATTI Iredale, 1933.
(Plate xii., fig. 20.)

1933. *Murphitella froggatti* Iredale, Rec. Austr. Mus., Vol. xix., p. 49, August 2, ex Brazier MS. Cairns, Queensland.
North Queensland (Cairns district).

MURPHITELLA BEDDOMEI Brazier, 1876.
(Plate xii., fig. 25.)

1876. *Helix* (*Rhytida*) *beddomei* Brazier, Proc. Linn. Soc. N.S.W., Vol. i., p. 98, July. Albany Is. and Cape York, Queensland.
North Queensland (Cape York district).

MURPHITELLA RAMSAYI Cox 1868.

1868. *Helix ramsayi* Cox, Mon. Austr. Land Shells, p. 30, pl. xviii., figs. 11, 11a, May. Richmond River, N.S.W. (MacGillivray).
New South Wales (Richmond River district).

Genus NAMOITENA Iredale, 1933.

1933. *Namoitena* Iredale, Rec. Austr. Mus., Vol. xix., p. 49, August 2. Orthotype, *Helix namoiensis* Cox.

NAMOITENA NAMOIENSIS Cox, 1868.

1868. *Helix namoiensis* Cox, Mon. Austr. Land Shells, p. 29, pl. xviii. figs. 10, 10a, May. Namoi River, N.S.W. (Scott).
New South Wales (Namoi River district).

SLUGS.

I am placing the Slugs at this end, not because this is their systematic position, but because so little is known about them and their affinities, all experts disagreeing, that no general conchologist can understand the attempts at classification.

Thiele (Handb. syst. Weicht., teil 2, p. 485, 1931) placed our native slugs in his Ordo Stylommatophora, in the fourth Stirps, Tracheopulmonata. As his third Stirps was Succineacea and his fifth Achatinellacea the association appears absurd. This Stirps Tracheopulmonata includes only one family, the Athoracophoridae for New Zealand, Australian and some Island slugs.

We have also in North Australia some other slugs referable to *Prisma* and *Vaginula* s.l. and these Thiele referred to a Stirps Soleolifera which preceded the Succineacea. Thiele recognised two families, Rathousiidae and Vaginulidae, placing *Prisma* as a section of *Atopos* in the former. The author of *Atopos* and *Prisma* described Australian species of *Vaginula*, very different looking slugs, which have been regarded as exotic, but these may be native. Under the circumstances I am merely recording the names and distribution of the species.

Family ANEITIIDAE.
Genus TRIBONIOPHORUS Humbert, 1863.

1863. *Triboniophorus* Humbert, Mem. Soc. Phys. & Hist. Nat., Geneve, Vol. xvii., pt. i., p. 116, figs. 2a-c. Haplotype, *Triboniophorus graeffei* Humbert.

TRIBONIOPHORUS GRAEFFEI Humbert, 1863.

1863. *Triboniophorus graeffei* Humbert, Mem. Soc. Phys. & Hist. Nat., Geneve, Vol. xvii., pt. i., pp. 116-120, pl. xii., fig. 2. Wollongong, N.S.W.

1865. *Triboniophorus schuttei* Keferstein, Zeitschr. für Zool., Vol. xv., p. 83, pl. 6. Sydney, N.S.W.

1865. *Triboniophorus krefftii* Keferstein, Zeitschr. für Zool., Vol. xv., p. 85, pl. 6; Add. p. 448, pl. 34, fig. 6. Sydney, N.S.W.

1893. *Aneitea graeffei*, var. *rosea* Hedley, Trans. New Zeal. Inst., Vol. xxv., p. 161, May. Bellendenker Mountains, Queensland.

1900. *Triboniophorus brisbanensis* Pfeiffer, Zool. Jahrb. (Abth. f. Morph.), Bd. xiii., pp. 293-358, pl. 17-20. Brisbane, Queensland.
New South Wales (as far south as Wollongong). Queensland (as far north as Bellendenker Mountains).

Note.—Grimpe & Hoffmann (Zool. Anz. (Leipzig), Vol. 58, pp. 171-177, January 20, 1924) have transferred *brisbanensis* to *Aneitea* typical, which suggests it was an introduced specimen.

Family Rathousiidae.

Genus Prisma Simroth, 1891.

1891. *Prisma* Simroth, Zeit. wiss. Zool. (Leipzig), Vol. lii., p. 596, October 2. Tautotype, *Veronicella prismatica* Tapp.-Canefri.

Prisma prismaticum Tapparone-Canefri, 1883.

1883. *Veronicella prismatica* Tapparone-Canefri, Ann. Mus. Civ. Genova, Vol. xix., p. 207, pl. xi., figs. 6-8. Sorong Is., Dutch New Guinea.

1885. *Prisma prismaticum* Heyneman, Jahrb. deut. Malak. Gessell., 1885, p. 13, February 5. Islands of Torres Straits.
North Queensland.

Prisma australe Heyneman, 1876.

1876. *Vaginulus australis* Heyneman, Journal Mus. Godeff., Vol. xii., p. 159. Gayndah, Burnett River, South Queensland.

1917. ? *Atopos* (*Prisma*) *australis* Odhner, Kungl. Sv. Vet. Akad. Handl., Bd. 52, No. 16, p. 90, pl. 3, figs. 99-100, text figs. 45-51, Herberton, North Queensland.
Queensland.

Family Vaginulidae.

Grimpe & Hoffmann have published a revision of the Indo-Pacific Vaginulids, and have created for them four genera, *Meisenheimeria, Vanigula, Semperula* and *Sarasinula.* The Australian recorded species are here mentioned under their names.

Genus Meisenheimeria Grimpe & Hoffmann, 1924.

1924. *Meisenheimeria* Grimpe & Hoffmann, Zool. Anz. (Leipzig), Vol. 58, p. 177, January 20; Zeitsch. Wiss. Zool. (Leipzig), Vol. 124, pp. 1-50, February 10, 1925. Orthotype, *M. frauenfeldi* Semper.

Meisenheimeria leydigi Simroth, 1889.

1889. *Vaginula leydigi* Simroth, Zool. Anz. (Leipzig), Vol. xii., p. 551, October 24. (Brisbane) Queensland. Abstr. in Journ. Roy. Micros. Soc., Ser. vi., Vol. x., p. 21, February, 1890.
Queensland.

Note.—Grimpe & Hoffmann (*loc. cit.*) have recorded this name as a synonym of *alte* Férussac, which they regard as ranging from India through the islands to South Queensland, and all similar slugs are considered to be conspecific.

Genus SARASINULA Grimpe & Hoffmann, 1924.

1924. *Sarasinula* Grimpe & Hoffmann, Zool. Anz. (Leipzig), Vol. 58, p. 177, January 20; Zeitschr. Wiss. Zool. (Leipzig), Vol. 124, pp. 1-50, February 10, 1925. Orthotype, *Vaginulus plebeius* Fischer.

SARASINULA HEDLEYI Simroth, 1889.

1889. *Vaginula hedleyi* Simroth, Zool. Anz. (Leipzig), Vol. xii., p. 552, October 24. Brisbane (Queensland). Abstr. in Journ. Roy. Micros. Soc., Ser. vi., Vol. x., p. 21, February, 1890.
Queensland.

Note.—Grimpe & Hoffmann (*loc. cit.*) have subordinated this to the New Caledonian *V. plebeius* of Fischer (Journ. de Conch., Vol. xi., p. 145, April 1, 1868).

While this was passing through the press I received an article published on the 10th February, 1938, in the Journal of Conchology entitled "Some New Australian *Thersites*", pp. 20-24, with one plate. It is a startling production as no reference to literature later than 1894 appears in it, and the authors, Clench and Archer, seem very unfamiliar with Australian shells. I have often wondered how an article written on American or European molluscs by means of the Australian Museum collection alone would be received in the countries concerned. Curiously, the Queensland molluscan fauna is so large that by the law of chances one of their five "new" species survives. The use of the generic *"Thersites"* for the different shells figured must look ridiculous to every conchologist who glances at the plate.

p. 20.—*Thersites darlingtoni* (MacPherson Range) is the same as my *Annakelea tympanum* (Austr. Zool., Vol. ix., p. 38, November 12, 1937, pl. iii., fig. 25) from the same locality. In this case there is excuse as though the species had long been known, it was described almost at the same time as its synonym.

p. 21.—*Thersites pterinus* (Lake Barrine) is not compared with *Gnarosophia bellendenkerensis,* though its sculpture is correctly given. While this may later be regarded as a race of *Gnarosophia,* it has no close relationship whatever with *Varohadra rainbirdi* with which its authors associated it.

p. 21.—*Thersites trachydermon* (Cardwell district) is obviously *Spurlingia nicomede,* but has nothing to do with *beddomae,* which is a *Gnarosophia.*

p. 22.—*Thersites monticola* (50 miles N.W. of Cairns) is apparently *Spurlingia portus,* which was described almost simultaneously.

p. 23.—*Thersites schevilli* (Hughenden district) is apparently a valid species of *Sinumelon.*

p. 24.—A note re *Chloritis banneri* with a figure (Plate i., fig. 6) is given, but I had discussed this species some years ago, and an excellent figure was on record in Cox's Monograph.

EXPLANATION OF PLATE XII.

Fig. 1. *Meridolum ascensum* Iredale.
,, 2. *Meridolum depressum* Hedley.
,, 3. *Rhynchotrochus macgillivrayi extensior* Iredale.
,, 4. *Galadistes liverpoolensis* Brazier.
,, 5. *Galadistes bourkensis* Smith.
,, 6. *Austrochloritis fringilla* Iredale.

" 7. *Ventopelita bellengerensis* Cox.
" 8. *Galadistes intervenens* Iredale.
" 9. *Austrochloritis metuenda* Iredale.
" 10. *Austrochloritis blighiana* Iredale.
" 11. *Discomelon intricatum* Iredale.
" 12. *Austrochloritis senticula* Iredale.
" 13. *Austrochloritis separanda* Iredale.
" 14. *Austrochloritis buxtoni* Brazier.
" 15. *Mussonena campbelli* Iredale.
" 16. *Offachloritis dryanderensis* Cox.
" 17. *Saladelos lacertina* Iredale.
" 18. *Trozena morata* Iredale.
" 19. *Saladelos hobsoni* Brazier.
" 20. *Murphitella froggatti* Iredale.
" 21. *Tasmadelos nelsonensis abitens* Iredale
" 22. *Saladelos bensa* Iredale.
" 23. *Saladelos helmsiana* Iredale.
" 24. *Strangesta glaciamans* Iredale.
" 25. *Murphitella beddomei* Brazier.
" 26. *Gloreugenia blackalli* Brazier.
" 27. *Torresitrachia stipata* Iredale.

EXPLANATION OF PLATE XIII.

Fig. 1. *Gloreugenia carduelis* Iredale.
" 2. *Xanthomelon interpositum* Iredale.
" 3. *Xanthomelon pachystylum sagenatum* Iredale.
" 4. *Xanthomelon pachystylum* Pfeiffer.
" 5. *Sinumelon marshalli* Iredale.
" 6. *Sinumelon finitinum* Iredale.
" 7. *Sinumelon subfodinale* Iredale.
" 8. *Xanthomelon pachystylum noscitum* Iredale.
" 9. *Xanthomelon pachystylum magnidicum* Iredale.
" 10. *Xanthomelon jannellei* Le Guillou.
" 11. *Xanthomelon genetivum lubricum* Iredale.
" 12. *Torresitrachia glomerans* Iredale.
" 13. *Xanthomelon minusculum* Iredale.
" 14. *Xanthomelon genetivum* Iredale.
" 15. *Sinumelon simulante* Iredale.
" 16. *Xanthomelon distractum* Iredale.
" 17. *Strangesta maxima* Mousson.

ERRATUM—pp. 127-161.

The captions at the top of the right-hand pages from 127 to 161 should be "Tillyard and Fraser."—Ed.

A RECLASSIFICATION OF THE ORDER *ODONATA*. BASED ON SOME NEW INTERPRETATIONS OF THE VENATION OF THE DRAGONFLY WING.

By R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.R.S., F.R.E.S.†

WITH NOTES, PREFACE AND COMPLETION THEREOF.

By F. C. Fraser, Lt.-Col. I.M.S., Retd., M.D., M.R.C.S., L.R.C.P., F.R.E,S.

Preface.

The untimely and tragic death of Dr. R. J. Tillyard in the early part of 1937, not only ended the career of a great scientist but robbed Entomology of much valuable knowledge which it might have acquired through the research work of one of its greatest students.

Among several valuable papers which Dr. Tillyard was engaged upon at the date of his death, was one dealing with a New Classification of the Order Odonata. This was to have been published in three parts, of which the first two had been practically completed.

Non-publication of this work would have been a loss to science; posthumous publication would be the best tribute to its author's memory. For these reasons, and because I had kept in close touch with him during its writing, both by correspondence and exchange of views, I have undertaken the responsibility of completing it and seeing it through the press.

At the outset, I was beset with certain difficulties, for a careful perusal of the MS. revealed a number of errors, one at least due, I think, to a *lapsus calami*, but sufficiently misleading as to be serious; others due to lack of references and material, or to accepting statements published by other authors at their face value.

The early part of the paper deals with venational problems and puts forward some new interpretations of these; the latter part bears more on classification but as of secondary importance to evolutionary problems, for the writer aptly says, that the problem of correctly classifying this enormous complex of forms is a purely secondary matter which can best be undertaken as a separate study by somebody with more first-hand knowledge of non-Australian forms than he can ever hope to obtain. For this reason, I have altered his title of the paper to one which is in more accordance with its subject matter. (Originally it stood simply as: "A New Classification of the Order Odonata".)

In undertaking to complete the paper, three courses were open to me—firstly to publish the MS. as it stood, a procedure which was open to the objection that certain serious errors, which it contained, might mislead the student. Secondly, to publish a corrected edition of the paper, giving a series of footnotes, pointing out where corrections had been made and the reasons for making them. Thirdly, to rewrite the paper entirely and assume joint responsibility for the views set forth therein. Such a procedure would have been unfair to the original author who would, now, not be able to disavow any fresh views which I might include; moreover, I was not prepared to accept a joint responsibility, since in some respects I did not see eye to eye with Dr. Tillyard. Thus I have elected to steer the

middle course and, whilst emending such passages as were likely to mislead the raw student of the Order, I have added explanatory notes to show where this has been done. Such footnotes have been kept down to a minimum, since it seemed more desirable to leave criticism, if any, to come from other quarters.

Although Dr. Tillyard's paper remains so lamentably incomplete, it is abundantly clear from so much of it as has been written that he had jettisoned his former theory that the whole of the Order Odonata has evolved from a simple-winged zygopterous type, in favour of one put forward by Professor Carpenter, which holds that the two suborders Zygoptera and Anisoptera have had independent origin from zygopterous and anisopterous types respectively.

This was extremely characteristic of his temperament, for he held that unless we were prepared to abandon the discredited theories of yesterday, science could hope for no advance on the morrow, or, at the least, it would be hampered in its advance. "I am no believer in Lost Causes", he wrote to me on one occasion.

Nevertheless, I have still sufficient faith in Dr. Tillyard's interpretations of the wing venation of the Odonata, especially of those relating to the remarkable changes which have taken place at the base of the wing, as to believe that he has been too precipitate in abandoning his former theory. I believe, and I shall attempt to show in Part II of this paper, that Professor Carpenter's epoch-making discoveries in the Permian beds of Kansas have been unduly overrated.

In the present Part I have called attention to structures in the costal border of the wing made up of the Costa, Subcosta, Radius and the two primary antenodal nervures, a complex which I call the "Costo-antenodal". A study of this has convinced me that it is of great phylogenetic importance and that the two antenodals are among the earliest structures evolved in the dragonfly wing. Whilst great importance can be placed on the structure of the primitive fossil wing, an equal reliance on vestigial structures existing in the wings of recent forms is necessary, since the two are complementary to one another.

I desire here to acknowledge much valuable assistance given me by Mr. John Cowley, especially in regard to the listing of genera and to the synonymy involved.

F. C. FRASER.

Bournemouth, Hants.

INTRODUCTION.

The oldest known winged insects, or the Pterygota, come from the Upper Carboniferous of Europe and North America. They fall into two types, viz., the Palaeoptera, a group of Orders characterized by their inability to fold their wings backwards so as to form a roof over the abdomen, and the Neoptera, another group of Orders in which the wings were, when in the position of repose, folded back in such a manner, thus forming a protective covering for the abdomen which was weakly chitinized in contrast to the tough, strongly chitinized head and thorax. To the Palaeoptera belonged the fossil Orders Palaeodictyoptera, Megasecoptera, Protodonata and Protephemeroptera; to the Neoptera, the fossil Orders Protoblattaria, Protorthoptera and the still existing Order Blattaria which was dominant in the Upper Carboniferous.

The only Palaeopterous Orders existing at the present day are the

Plectoptera or Mayflies, and the Odonata or Dragonflies. They stand far apart from one another, but much farther apart from all other existing insects. In contrast with the early success and almost constant form and venation of the Cockroaches (Order Blattaria), the Mayflies and Dragonflies exhibit a surprisingly changing ancestral history and the present-day types in both Orders were not attained until the Upper Jurassic or later. In the case of the Mayflies, the evolutionary changes involved heavy reduction of the size and venation of the hindwing, with complete loss of mouth-parts in the adult insect. Thus the struggle for existence was for the most part transferred to the larvae, which therefore, at the present day, offer us characters of greater value in classification than do the adults. In the case of the Dragonflies, the fore and hind wings remained in the primitive condition of being equal in size and similar in venation in all the more primitive (Zygopteroid) types. But a new line arose in the Jurassic in which the hind wing became more specialized than the fore, and also tended to become somewhat broader; these were the larger present-day types called Anisoptera.

The fossil record shows that the evolutionary ancestry of the Dragonflies is unexpectedly complex. Lameere, through a brilliant analysis of the old Order Palaeodictyoptera, and an equally brilliant concept of the original, ancestral type of venation, has laid the foundation of a sound understanding of the evolution of both the main groups of Palaeoptera; these he called the "Ephemeroptera" and the "Odonatoptera". Since, however, the ending "ptera" is used in the Class Insecta to indicate groups of the rank of Orders, and Lameere's groups have the rank of Superorders, I must change the name "Ephemeroptera" to "Plectopteroidea", indicating a Superorder consisting of Orders allied to the Mayflies or Plectoptera, and the name "Odonatoptera" to "Odonatoidea", indicating a Superorder, consisting of Orders allied to the Dragonflies or Odonata.

The Venation of the Palaeopterous Orders.

Because most of the fossil insect-remains known to us are wings, the study of insect evolution resolves itself chiefly into a study of the evolution of various types of wing-venation. The vast knowledge of new types of fossil insect wings accumulated since the publication of Comstock's famous book ("The Wings of Insects", 1918) has shown conclusively that his hypothetical ancestral type of wing-venation is by no means an old type geologically, and that a much older and more complete hypothetical type is needed if we are to understand the venations of more archaic orders. Comstock failed to appreciate the earlier work of Audouin with its insistence on the importance of alternating convex and concave veins. But it is just in the older types of insect wings, and more especially in the Palaeoptera, that this alternation of convex and concave veins is found to be of the utmost importance. Indeed, it may confidently be asserted that, as long as the wings retained their primitive position of being held, when at rest, free from the abdomen without being folded roof-wise above it, so long did the primitive alternation of convex and concave veins remain unchanged, even when one or more of the original main veins had been eliminated.

In order to understand the venation of the Odonata, we must first of all be perfectly clear about the ancestral Palaeopterous type postulated by Lameere. According to Lameere, each vein arising from the base of the wing originally divided into two branches, an upper or anterior convex and a lower or posterior concave one. There are five separate veins at the base

of the wing, viz., the Costa, Radius, Media, Cubitus and Analis. Each of these except the anal, divides into another convex and posterior concave main veins, according to the following Table:—

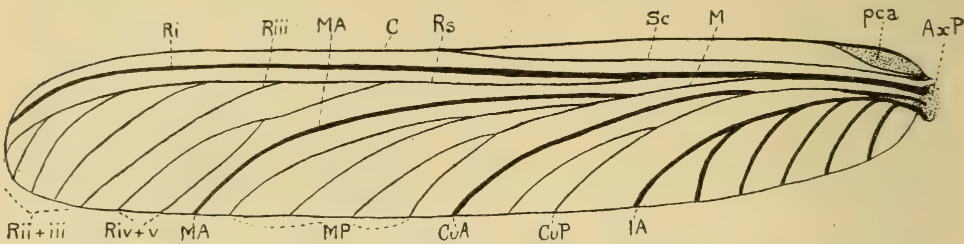


Fig. 1.—*Dictyoptilus sepultus* Handl.

Table of Alternating Convex and Concave Veins in Palaeopterous Orders.

Basal Vein.	Main Logitudinal Vein.	Type.	Ideal Notation.	Usual Notation.
COSTA.	Costa.	Convex.	CA.	C.
	Subcosta.	Concave.	CP.	SC.
RADIUS.	Radius.	Convex.	RA.	R.
	Radial Sector.	Concave.	RP.	Rs.
MEDIA.	Anterior Median.	Convex.	MA	MA.
	Posterior Median.	Concave.	MP.	MP.
CUBITUS.	First Cubitus.	Convex.	CuA.	Cu1.
	Second Cubitus.	Concave.	CuP.	Cu2.

This arrangement is well shown in the genus *Dictyoptilus* (Fig. 1).

Comstock failed to recognize the existence of the anterior median, MA, and thus his hypothetical type included only the concave posterior branch of the ancestral median vein. He also failed to homologize correctly the two main branches of the Cubitus in various Orders, paying no attention whatever to the convexity or concavity of the main veins, and selecting as his Cu2, in certain Orders, the vein which we now know to be the convex first anal (1A).

The anal veins present a special problem which I do not think has yet been fully solved. No type of wing is really known, even amongst the oldest fossils, where a true concave anal vein exists. In those Palaedictyopterous and Plectopterous wings in which the basal connections of the anal veins can be clearly seen, it can be established beyond doubt that any concave veins present in the anal region are of the type known as "intercalated" or "triadic" veins.

In the present state of our knowledge, we can recognize three types of structure in the anal region of the wing, as follows:—

(1) The oldest type, or Plectopteroid, in which, instead of a true third axillary at the base of the wing, there is a series of weakly chitinized plates constituting the *posterior axillary region*; from

these are developed a varying number of convex anal veins, of which the first two at least (A1 and A2) are separated by a concave intercalated vein, the inter-anal, 1A1.

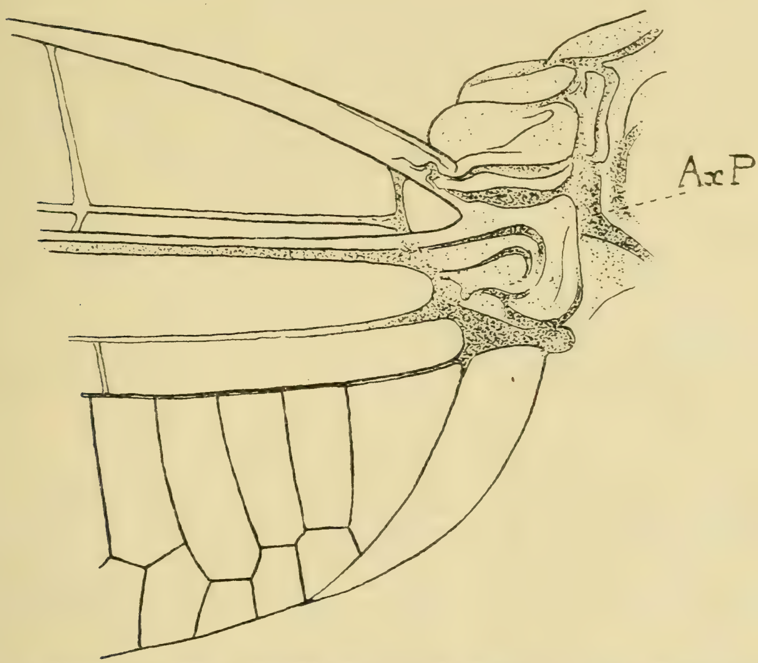


Fig. 2.—Odonatoid type of wing; base only shown. *AxP.* Axillary plate.

(2) The Odonatoid type, in which the weakly chitinized plates found in the older Plectopteroid types are replaced by a single stoutly chitinized *axillary plate* (*AxP* in Fig. 2) to which are attached *all* the posterior veins of the wing, viz., the Radius, Media, Cubitus and Anal.

(3) The Neopteroid type, in which the original series of weakly chitinized plates found in the Plectopteroid type is replaced by a set of three strongly chitinized and distinct axiliaries, (1Ax, 2Ax and 3Ax). The whole of the anal veins in the Neoptera appear to have been evolved in intimate relationship with the third axillary (3Ax), and all the anal veins present are always convex veins. From a study of fossil types, I am of opinion that there are only two anal veins originally in the Neoptera, viz., 1A and 2A (or, if preferred, A1 and A2). The so-called third anal (3A) of Comstock can be clearly seen in such ancient Orders as Protoperlaria, to be nothing else than a posterior convex branch of 2A. If, therefore, we continue to use the notation 3A, we must always remember that it is only for convenience and that this vein, and 4A when present, are only branches of the second anal vein.

Reviewing the above evidence, we see that the most ancient type of

all, the Plectopteroid, could very well be the ancestral type for the whole of the Neoptera. At the present day, these latter form the great majority of winged insects and include all the existing Orders of Pterygota except the Mayflies and Dragonflies. But the Odonatoid Orders form an evolutionary side-branch from the Plectopteroid type, characterized by great strength of wing-veins and wide-membrane by the locking together of all the main veins of the wing except the costa, through the development of the strong unyielding *axillary plate.* In other words, while it is true that the Mayflies and their ancestors could not flex their wings so as to fold them roofwise over the body, yet the basal mechanism of this kind of wing was of such primitive type that a flexor mechanism could still have been developed. In the Odonata and their ancestors, specialization has proceeded too far to allow of this latter possibility; thus we note that when, at a later stage, types of dragonflies were evolved in which the wings could *apparently* be folded back along the abdomen, this position was not achieved by flexing the wing at all, but by evolving an obliquely placed thorax and retaining the original method of folding the wings vertically above the body! Correlated with this condition of the wings, we find a single posterior axillary plate (AP) and a single convex anal vein. As this vein is almost certainly the homologue of the first anal of the Mayflies, it is here named 1A.

The Odonatoid Type of Venation.

It is only in the Plectopteroid groups that the original costal vein C or CA remains distinct from the costal margin of the wing In all Neoptera it has disappeared entirely, or perhaps we should say that it has become merged in the costal margin. In the Odonatoid Orders, we find, in the oldest types, a hardened *precostal area* (Figs. 1, 4, 5) which appears to represent a secondary margin and the costal vein near the base of the wing. Even in some modern types, e.g., *Petalura* and *Sieboldius,* a remnant of this area can still be recognized, but in most forms, it is merely represented by a thickening of the costal margin basally

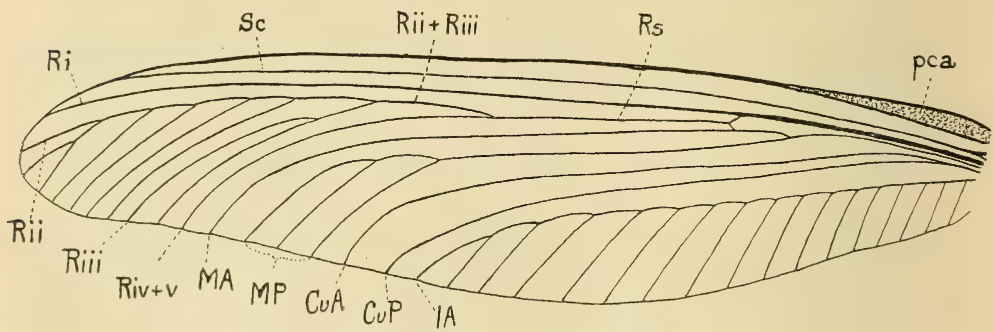


Fig. 3.—*Protagrion audouini* Brong.

Both in the Plectopteroid and Odonatoid groups, the original type of branching of the radial sector is altered by the addition of intercalated sectors. The original type of branching is that found in the Palaedictyoptera, viz., a series of descending branches arranged pectinately (Fig. 1). *All these branches are concave veins.* In the oldest types, Rs.

divided not far from its origin into R2 + 3 and R4 + 5, but further additional branches were only added to the former, leaving R4 + 5 as a simple vein throughout the whole series. In all but the oldest groups of Odonatoidea, the branches of R2 + 3 become standardized into two true concave branches, R2 and R3, and two intercalated sectors, 1R2 and 1R3, both of which, of course, are convex veins (Fig. 8).

Originally, both in the Plectopteroidea and Odonatoidea, Rs was quite separate from MA. But very early in the evolutionary history of both groups, the basal portion of MA became obsolete and this vein then became completely attached to R. The composite vein so formed is labelled Rs + MA in most figures in this paper.

The Nodus.

Except in some of the earlier fossil types of Odonata, we meet with a specialization in the form of the subcosta, which becomes more or less shortened and meets the costa in a more or less specialized manner at the nodus ("N" in figures). In all living types of Odonata, the costa is flexible at the nodus, (i) and this flexibility gives the insect increased powers of flight. The history of the evolution of the nodus, as shown in the fossil record, indicates that it was at first nothing more than the upturned end of the subcosta, Sc., meeting the slightly downwardly bent costa, as in *Kennedya* (Fig. 6). But already, as in *Kennedya* there were cross-veins situated near the nodus, both proximally and distally. The next step was for one set of cross-veins, consisting of a nodal veinlet (nv) and a subnodal veinlet (snv) lying below it, to approach the nodus more closely and to become obliquely placed so as to form a strut beneath the end of Sc. This stage is well shown in Permagrion (Fig. 7). To attain the present-day form of nodus, it was only necessary for the supporting strut to move close enough to the nodus to leave only a very short projecting end of Sc. beyond them; this portion then became strongly upturned, often almost at right-angles to the costa, while the angle between it and the nodal vein below it became more and more obtuse. The subnodal veinlet also became strengthened to form the subnodus (Fig. 7, *sn.*), (ii).

The Pterostigma.

Another important specialisation found in most Odonata is the pterostigma (*pt* in figs.). This is a more or less strongly chitinized area

---

(i) Dr. Tillyard is surely incorrect here : the nodus is not a joint and can hardly be designated as a "pseudo-joint". I have put a few wings to the test by attempting to flex them at the nodus and find that the costal border first of all goes into a spiral twist, then buckles and finally snaps off at the distal side of the nodus. Actually the nodus represents the distal end of the costoantenodal complex which I describe fully in footnote (ii) and from it are splayed out the apical portions of the wing. A joint in this position would result in a flapping, helpless wing, since without musculature, it would buckle at every stroke. Fraser.

(ii) *The Costoantenodal Complex* (Fig. 11).

With the formation of the nodus, the three nervures Costa, Subcosta and Radius become strongly bound together proximally and distally and this union is further strengthened by two antenodal nervures which are situated nearly midway between the nodus and base of wing and a short distance from one another. These antenodals are formed by two short

situated between costa and radius, somewhat before the apex, at the region of greatest impact of the wing on air during flight. Originally it appears to have covered only a single cell, i.e., the space between two consecutive cross-nervures, but in some of the most heavily veined recent forms it may cover a space equivalent to a number of small cells. In a few forms (e.g., the Pseudostigmatidae), (Fig. 20), it becomes hypertrophied or abnormal, while in others (males of some Agriidae) it is obsolete.

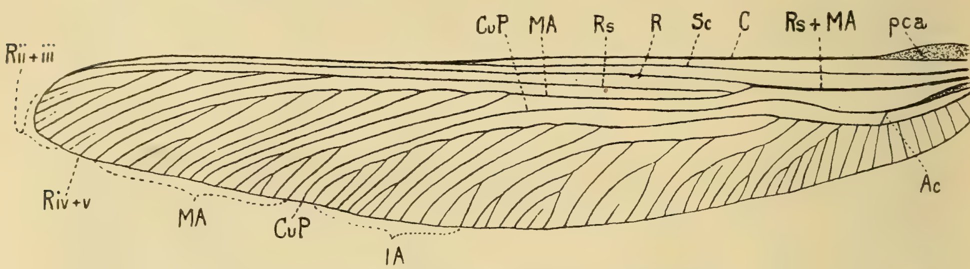


Fig. 4.—*Typus permianus* Sell. Forewing.

The Arculus.

The most important specializations in the wings of Odonata occur in the region of the *arculus* (Figs. 7, 9b). We have mentioned already that, in almost all Odonata, the original stem of MA has been lost, so that this vein becomes attached secondarily to Rs. The arculus may be defined as the free basal portion of Rs + MA after it leaves the common stem with R, together with any supporting cross-vein beneath it. In recent forms (Fig. 23) the complete arculus consists of two parts, viz., *the anterior arculus* formed from the strongly bent basal portion of Rs + MA and the *posterior arculus* formed from a specialized cross-vein below it. The fossil record shows how this specialized form of complete arculus arose. There is, first of all, as in *Kennedya* (Fig. 9B) and *Ditaxineura*, only the oblique weakly specialized free basal portion of Rs + MA, without any supporting cross-vein below it; the cross-vein that comes nearest in position at this stage is the discoidal cross-vein, *dv*, (Fig. 9), which is destined to play an entirely different part, as we shall see when considering the evolution of the discoidal cell or quadrilateral. Consequently, in some primitive

---

cross nervures which run from the Costa and Radius to meet at the same point on the Subcosta, and since the latter is concave to the Costa and Radius, the two halves meet at an agle. Moreover the costal plane or space enclosed between the Costa and Subcosta, is at an angle to the subcostal plane, or space between the Subcosta and Radius, so that the whole structure is one of great strength and resembles an angle-iron girder reinforced by two strong angle-irons at its centre. The two antenodals are known as the "primaries", since they are found in the earliest known fossil wings of dragonflies (Fig. 6); later we shall see that they are joined by other, weaker antenodals, the two halves of which fail to coincide, known as "secondaries"; and later still in evolution, the primaries are entirely replaced by the secondaries, a stage which represents the highest point of evolution attained by the Order. The whole structure composed of Costa, Subcosta, Radius and the two primary antenodals is known as the "Costoantenodal complex". Fraser.

types, we find that the arculus is *incomplete* (e.g., *Permagrion, Permolestes* and forewings of *Hemiphlebia* and *Chorismagrion*). Later, a cross-vein became developed beneath the anterior arculus, and this not only completed the arculus itself, but at the same time turned the open space below it into a closed quadrilateral (iii).

The Discoidal Cell.

Of all areas in the Odonate wing, the discoidal cell (*dc*), (Fig. 14), is the most important and most highly specialized. We have seen in the preceding paragraph, that this area was not originally a closed cell, and that it still remains open in the forewings of two living genera of dragonflies (*Hemiphlebia* and *Chorismagrion*). In all other living types, it is completely closed and either entire or divided. It lies between the free basal piece of MA above and the somewhat curved or bent portion of CuP below; its proximal side is the *posterior arculus*, and its distal side, often very obliquely placed, is the original *discoidal cross-vein* (*dv*) (Fig. 9B). A study of fossil forms will easily convince us that the predetermining factor for the formation of this cell was simply the curious sigmoidal curvature of vein CuP in the region of the arculus whereby the evolution of a cell of specialized form was rendered possible.

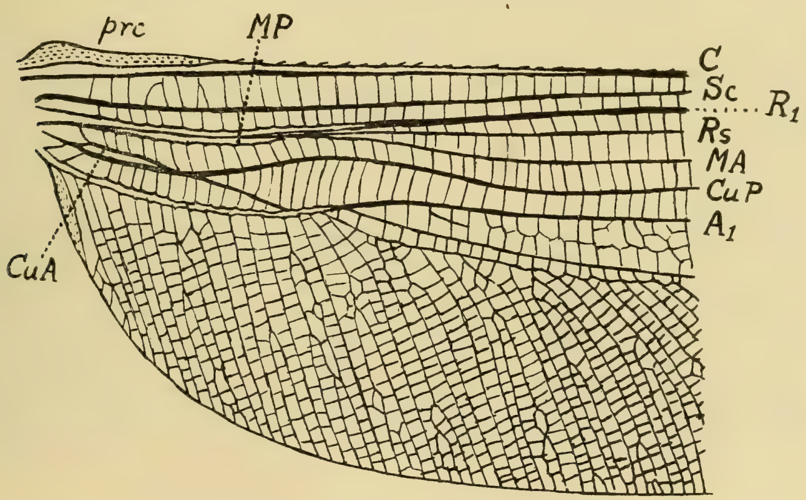


Fig. 5.—*Megatypus schucheri.*

In all Zygopteroid types, the discoidal cell remains a quadrilateral. In some Anisozygoptera of Mesozoic times, the hindwing outran the fore

---

(iii) The level of the arculus in primitive forms is slightly distal to the level of the distal primary antenodal nervure. As we trace evolution upwards, towards recent forms, it is seen that the level of the arculus becomes recessed towards the base of the wing : at first at and in line with, the distal antenodal, then at a level midway between the two antenodals and finally, in many recent or present-day forms, it actually lies nearer to the level of the proximal antenodal. Thus the level of the arculus is of primary importance in estimating the stage of evolution reached. Fraser.

in specialization, so that we find forms in which the forewing retained the quadrilateral while the hindwing built up a much more specialized subdivision of this cell into a triangle-plus-supratriangle In the true Anisoptera, the original quadrilateral is subdivided into triangle-plus-supratriangle in both fore and hind wings. (The Anisozygoptera and Anisoptera will be dealt with more fully in a later part of this paper).

The Subquadrangle.

The only other specialized region now remaining to be considered, is that known as the subquadrangle (*sq* in figs.) lying below the quadrilateral in the region between CuP and 1A. The subquadrangle has ceased to be of much importance in the study of modern types, yet when we look at the earlier fossil forms, we are surprised to find that it existed in the form of a completely closed cell well before the time when the discoidal cell itself became closed, e.g., in *Kennedya* (Fig. 9B), *Permolestes* (Fig. 8), and *Permagrion* (Fig. 7). There can be no doubt that in these three fossil forms, veins CuP and 1A were fused basally; the subquadrangle is formed as the first enclosed cell after CuP diverges from 1A below the region of the arculus. But in the Hemiphlebioidea (Hemiphlebiidae) we meet with the older arrangement in which the vein 1A remains distinct from CuP throughout; instead, it is basally fused for a greater or less distance with the posterior border of wing. On the Anisoptera, an even more primitive arrangement is retained, viz., that veins CuP, 1A and the posterior margin of wing are all separate and distinct from the base of wing outwards (iv).

The Anal Crossing.

The above differences have not been understood clearly up to now, and hence there is some ambiguity in the use of the term *anal crossing* for the cross-vein which connects CuP with the posterior margin of the wing near the distal end of the petiole in Zygoptera. This cross-vein is laid down along the course of the anal trachea of the nymphal wing, and therefore the term *anal crossing* (Ac), which I originally gave it, must be strictly understood to apply to this fact only; it must not be concluded that the anal vein also always follows this course. It does so, obviously, in *Kennedya, Permolestes* and *Permagrion*. In *Hemiphlebia* (Fig. 13) the anal vein can be followed as a distinct vein from the base of the wing, lying in contact

---

(iv) It will be seen that here, Dr. Tillyard follows Carpenter in arguing an individual origin of the two suborders Zygoptera and Anisoptera, from a Protozygopterous and Protanisopterous ancestor respectively. It is on this crucial point that I fail to agree with him, since to accept such a theory is to argue that the Nodus, Arculus the Primary pair of antenodal nervures and the nervure Ac (*Cuq* of Ris) all had an individual origin. Such a coincidence is beyond credence, as all these are common to and identical in the two suborders. As will be seen later on, Dr. Tillyard states that the nervure Ac in *Hemiphlebia mirabilis* is *a mere cross-vein,* whilst in the whole of the Coenagriidae it is the site of the crossing over of the nervure 1A; the nervure in *Hemiphlebia* is absolutely identical to the rest of the Coenagriidae in structure and position, and the same may be said for it in the whole of the Anisoptera, where it is clearly vestigial in character.—Fraser.

with the posterior margin of the wing, but distinctly separated from it as a fully chitinized main vein, throughout the petiole (v).

There is one other important point to bear in mind concerning the venation of the Odonata. From the very beginning of the Order, apparently through the narrowing of the wings, the two veins MP and CuA, which are of the greatest importance in other Orders, were suppressed. Their basal remnants can be seen in the Meganeuridae (Fig. 5), and the free basal piece of CuA, still extant, is clearly visible in *Kennedya* and *Permolestes*. In all recent forms, not a trace of either of these main veins can be found.

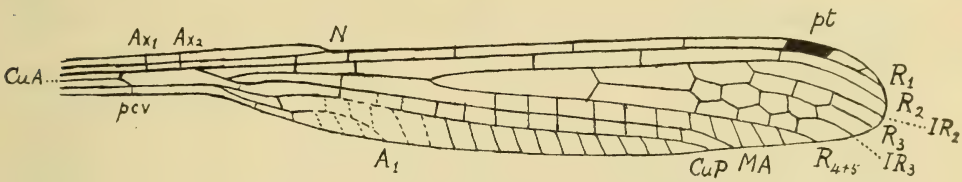


Fig. 6.

Now if we look at the petiole in *Kennedya* (Fig. 9A) and that of *Permolestes* (Fig. 8), we find that the downturned end of CuA, where it falls on to CuP, is supported below by a short cross-vein between CuP and the posterior margin of wing. This is the true *Postcubital cross-vein* (*pcv*). It might have been imagined that no trace of this cross-vein could be found to exist in any living type. But such is not the case, for if we study carefully the venation of the Platystictidae, we find that this postcubital cross-vein is still in position (Fig. 14) and placed far proximal to the level of the proximal antenodal nervure, while the true anal-crossing (Ac) still forms part of the original subquadrangle. In this remarkable character the family Platystictidae are the most archaic group of Odonata living.

Cross-veins.

The Odonatoid and Plectopteroid Orders differ from the Palaeodictyoptera in not possessing a primitive archedictyon of weakly chitinized

---

(v) I have examined a considerable number of wings of *Hemiphlebia mirabilis* Selys, to check this statement and find that the anal vein existing as a separate entity as far as the base of the wing is by no means constant. In text-figure 13 I show the various conditions of this vein as existing, not only in different specimens, but even in the wings of individual specimens. Morton was the first to call attention to this peculiarity in the wing of Hemiphlebia, which had been pointed out to him by the late Dr. Ris and described by the latter as "A minute cross-vein detached from the anal margin just at the Cuq". Morton states that it does not appear to be constantly present and that Tillyard's figure truly represents the condition of an example in his collection. It should be added that this figure does not show any evidence of a separated anal vein. In the specimens examined by myself, it exists as a separate entity to near the base of wing in one wing only.—Fraser.

polygonal cells. Instead, their cross-vein system is chiefly made up of single cross-veins, strongly chitinized and placed more or less at right angles to the main veins which they connect. Only in special areas of the wing, where a larger space than usual is left between branches of main veins, are polygonal cells developed.

The fossil history of the Odonata shows that the earliest types possessed relatively few cross-veins. The Kennedyidae (Fig. 6) and Hemiphlebiidae (Fig. 12) possess the lowest number. An abundance of cross-veins is to be regarded as a specialization by addition.

Having now indicated the principal specializations in the Odonatoid form of wing-venation, we may proceed to the working out of a new scheme of classification for the Odonatoid Orders of Insects (vi).

Twenty years ago, it would have appeared that the main lines of the Classification of the Order Odonata or Dragonflies were already satisfactorily fixed and that but little remained to be effected in the way of major alterations or improvements. It was true, of course, that comparatively little was known about the actual evolution of the Order. The geological record was at that time a very broken one and consisted mainly of three separate groups, viz.: (1) the gigantic Meganeuridae of the Upper Carboniferous, which were not recognized as true Odonata, but were relegated to the older and long extinct Order Protodonata; (2) the complex of forms found in the European Lias, many of which were recognized as belonging to the Suborder Anisozygoptera; and (3) a number of interesting Tertiary genera, which were admittedly too closely allied to recent forms to be of much value in the study of the evolution of the Order.

(vi) In working out the phylogeny of the Order Odonata, it is very necessary to compare the wing of an archaic form such as *Kennedya mirabilis* Tillyard, with examples of those belonging to the various families composing the Order, so that one may note the various tendencies which evolution has exhibited in the building up of the wings. These tendencies may be briefly catalogued in chronological order as follows:—1.—A gradual shortening of the subcostal nervure. 2.—The alignment of the two primary antenodal nervures. 3.—The formation of the Nodus and so the Costo-antenodal Complex. 4.—The formation of the Arculus. 5.—The formation of the Discoidal cell, first as an open cleft between main nervures, then a closed quadrilateral, and finally, through bisection of the latter, as two unequal triangular cells. 6.—The recession of the Arculus, Discoidal cell and origins of the nervures R4 + 5 and IR3 towards the base of the wing. 7.—The lengthening of the Costo-antenodal Complex so as to bring the Nodus nearer the centre of the wing, the primary antenodals lagging behind meanwhile and so lying nearer the base of wing. 8.— The appearance of secondary antenodal nervures in the costal and subcostal spaces, the two sets not coinciding at first, but eventually so. When the whole have coincided the primaries become merged in them and disappear. 9.—The broadening of the base of the wings, especially that of the hind and especially in the Anisoptera. 10.—The appearance of cross-nervures in the median or basal space in many genera especially in recent forms. Lastly, it should be grasped that anisoptery, the normal condition in the Anisoptera, is not confined to that Sub-order, but is very marked among the higher forms of the Zygoptera.—Fraser.

It was the discovery of true Odonata in the Lower Permian of Kansas (Tillyard, 1923, 1925 and 1926) that was the actual event which threw the accepted classification into the melting-pot. But such events do not become historical merely by their occurrence; they only take on a historical significance later, when they can be seen in true perspective. Thus it merely fell to my lot to record the occurrence in the Kansas beds of both Meganeuridae and forms that I considered to be true Odonata, allied to the Zygoptera, and for which I proposed the new Subordinal name Protozygoptera. The actual fossil forms placed by me in the new Suborder were *Kennedya* Till., *Opter* Sell., and *Ditaxineura* Till. The latter, however, was only represented by the apical portion of a wing and when, later on, Carpenter (1931) discovered a complete wing of this interesting genus, he was easily able to demonstrate that it had no affinity with *Kennedya* and *Opter,* but belonged to a new Suborder to which he gave the name Protanisoptera, and which he believed with justice to have been ancestral to the Mesozoic Anisozygoptera.

The next stage towards the completion of the evolutionary history of Odonata was the discovery of further Lower Permian forms in Russia (Martynov, 1930). These were two species of the genus *Sushkinia* Mart., allied to *Kennedya* Till., and placed in the same family Kennedyidae. About the same time, Carpenter (1931) added the new genus *Progoneura* to the Kennedyidae, from the Lower Permian of Kansas, in the same paper in which he demonstrated the true nature of *Ditaxineura.*

In Russia, Martynov (1931) described two more new species from the Lower Permian, belonging to the new genus *Permaeschna,* and placed them in a further new Suborder Protanisoptera, accidentally choosing the same name as Carpenter had employed for the new Suborder which he had erected to contain *Ditaxineura.* (Although both Carpenter's and Martynov's papers were published in the same year, Carpenter's has priority, as it was issued first (February, 1931). The genus *Permaeschna* is still incompletely known, but it appears highly probable that it must fall within the same Suborder as *Ditaxineura.*

In the following year, Zalessky (1932) described another interesting genus, *Pholidoptilon,* from the Permian of Russia. Unfortunately this author's knowledge of Odonata is restricted, and another new subordinal name, Permodonata, was added to the rapidly growing list on insufficient grounds.

The fascinating story of the Suborder Protanisoptera was brought to a close for the time being, by the discovery of another new type of wing (Tillyard, 1935), *Polytaxineura* Till., in the Upper Permian of Australia. From a comparative study of all the known types within the Suborder, I was then able to show that it contained two very distinct families, viz., the Ditaxineuridae, containing the single genus *Ditaxineura* Till., and the Polytaxineuridae, containing *Polytaxineura, Pholidoptilon* and most probably also *Permaeschna* (vii).

On the Zygopteroid side, the Permian record was gradually enriched, firstly by the description of the fine new genus *Permagrion* (Tillyard, 1928) from the Upper Permian of the Falkland Islands, and secondly by an addition to the Lower Permian of Russia, *Permolestes* (Martynov, 1932). Each

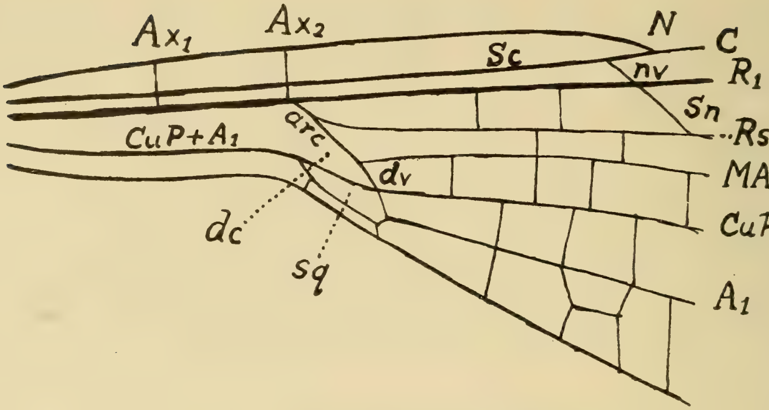


Fig. 7.—*Permagrion falklandicum* Till.

of these fossils possesses complete wings, and each was rightly placed in a separate family. But while *Permolestes* was placed by Martynov within the Suborder Protozygoptera, the Upper Permian *Permagrion* was recognized by myself as being the oldest known member of the Suborder Zygoptera.

Unfortunately the record for the Trias is, up to the present, a poor one. From the Upper Triassic or Rhaetic of Ipswich, Queensland, several forms have been described, but practically all of these are too fragmentary for accurate placing in the scheme of classification. In only one genus, *Triassolestes* Till., is the discoidal cell preserved, and this indicates that the genus stands well inside the true Zygoptera.

I suppose that it would be a truism to assert that, if modern scientists had the complete fossil record of any group ready to their hands, their adopted system of classification would inevitably break down. For all the evolutionary streams in Time are absolutely continuous, and it is only by the elimination of the connecting links that separate species, genera families and orders have arisen. In the case of the Odonata, the interesting position is now arising—indeed it has actually arisen—in which the discovery of annectent fossil forms has obliterated to a large extent the clear-cut distinctions of yesterday, and the question remains —What procedure are we to adopt in the face of such facts?

Two problems have to be faced. The first is—"How are we to deal with the annectent forms themselves in any scheme of classification?" The second is—"How are we to make the major divisions in the whole Odonatoid Complex conform more closely to the new evidence now available?"

The first problem I propose to solve in what appears to me to be the only possible way. Annectent forms should be clearly marked as such, but each should be placed at the end or beginning of that group to which it shows, on a careful analysis, the most marked affinity, with a definite indication also of the group to which, when so placed, it is annectent.

The second problem is the real justification for the present paper,

since it becomes more and more evident, as the discoveries in fossil Odonatoid types multiply, that the present classification is seriously in need of revision, if it is to prove a useful and correct guide to students of the group.

As a starting point for the new classification, I desire here to introduce a remark made by my good friend, Professor A. Martynov. In 1932 (Martynov, 1932, p. 17) he wrote concerning my new interpretation of the wing-venation of the Meganeuridae——"Tillyard proposed (1925, 1928) a quite different interpretation. According to it, the wing-venation in Meganeuridae proved to differ from that in the Protagriidae more strongly than one could think earlier, and I cannot understand why Tillyard has preserved both these same families in the same order".

Martynov then goes on to propose a separate order for the family Meganeuridae, naming it the Order Meganisoptera.

My reply to Martynov is that it was exactly because I desired to avoid this unnecessary multiplication of new Orders that I decided to leave the Meganeuridae within the Order Protodonata, *for the time being.* The differences between *Meganeura* and *Protagrion* were quite as clear to me as they were to Martynov, but I realized that it would require a little of that historical perspective of which I spoke about earlier in this paper, to enable anyone to make a wise use of these differences in readjusting the classification, and therefore I was content to leave the question of reclassification out of my paper. After an interval of more than ten years since my first paper on the Lower Permian Odonata was published, I now think that the necessary historical perspective has been attained, and certainly the available evidence from recorded fossils is very much greater. It is now quite evident to me, and might, I think, have been evident to Martynov in 1932, that a *new Order is not required for the family Meganeuridae.* The completion of the fossil record now gives us a long, single series of forms, in which the evolution of the *nodus* is shown with almost startling clarity, beginning with the normal, simple, elongated subcosta (Meganeuridae), (Fig. 4), and passing on to the Protanisoptera, where the subcosta begins to regress towards the base of the wing and also shows the first sign of nodal formation at its apex, through the specialization of a neighbouring cross-vein into a more or less oblique vein (the nodal veinlet, *nv*), which is destined to link up with Riv + v by means of an intermediate cross-vein, the subnodus (*sn*) lying between R1 and Rs. We can say, of the Meganeuridae, that none of them possessed a true nodus. Of the Protanisoptera, on the other hand, we can say, with equal truth, that nodal formation has begun, though it is in a far more primitive stage in the Lower Permian *Ditaxineura,* for example, than it is in the Upper Permian *Polytaxineura* or *Pholidoptilon.* Another line of evolution of the nodus is shown in the Protozygoptera where the distal end of the subcosta becomes greatly regressed towards the base of the wing (Kennedyidae) long before the first signs of true nodal formation become apparent.

Reviewing the whole series in perspective, it now appears to me that nothing can be gained by any attempt to make a clear-cut division anywhere in the series of nodal forms. The series is already far too complete for such a division to possess any real value; we may readily grant that the position will become worse with the discovery of each new Palaeozoic fossil form.

Thus one of the main characters which at present separate the Order Protodonata from the Order Odonata is no longer of value.

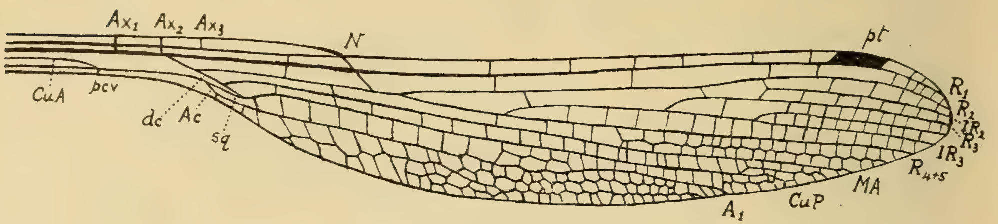


Fig. 8.

A second evolutionary line is exhibited in almost as complete a fashion, in the formation of the *discoidal cell.* It begins in the strong sigmoidal waving of CuP and 1A in the Meganeuridae (Fig. 4) and is continued into the Ditaxineuridae and Kennedyidae with only a single important difference, viz., that the number of cross-veins is very greatly diminished. In none of these forms is a true discoidal cell developed, but it is possible in both Ditaxineuridae and Kennedyidae to indicate that particular cross-vein (the discoidal cross-vein, *dv*) which, later on, is destined to form the distal side of the quadrangle (discoidal cell). The "open discoidal cell" of such types as *Permagrion, Permolestes, Hemiphlebia* (forewing only and *Chorismagrion* (forewing only), is formed merely by a change in the character of this cross-vein *dv,* which begins as a short cross-vein, more or less at right-angles to the main veins which it connects, and develops into an oblique vein continuing the course of the arculus downwards.

It will be abundantly clear, therefore, that if we desire to retain the Meganeuridae within the Protodonata on the ground that these forms possessed no true nodus, then it would be very difficult to omit some of the Lower Permian forms placed in the Protozygoptera and Protanisoptera especially *Kennedya.* If, on the other hand, we desire to retain the Meganeuridae within the Protodonata because of the absence of a discoidal cell, then it is clear that *Ditaxineura, Kennedya* and allies would have to be removed to the Protodonata with them.

Martynov is quite correct of course, when he states (1932, p. 17) that the affinities of the family Meganeuridae are much closer to the Protanisoptera and Anisoptera than they are to the remaining Protodonata.

Here it is necessary to ask ourselves what would be left of the Order Protodonata if we removed the dominant group Meganeuridae from it? The original genus on which the Order was founded by Brongniart (1898) was Protagrion Brong. (Fig. 3). This genus, together with two allied genera from the Permian (*Calvertiella* Till., *Tillyardiella* Mart.), differ markedly from the Meganeuridae and all true Odonata, and agree closely with the Palaeodictyoptera in possessing a full complement of original convex and concave veins. In these forms, the concave vein MP and the convex vein CuA remain complete. In the Meganeuridae only small portions, at the base, of both these veins are still preserved. In the Kennedyidae and Ditaxineuridae, MP is completely suppressed, and only

a short basal piece of CuA is retained within the "basilar space" lying between R + M above and CuP below. In all forms of Odonata from the Upper Permian to the present day, as far as they are known (with the sole possible exception of *Tarsophlebiopsis* Till.), both MP and CuA have been completely suppressed.

It thus appears to me that the only possible subdivision which can at present be made between the Protodonata and the Odonata must be based upon a single very important character, viz., the presence or absence of the complete veins MP and CuA and therefore *the Meganeuridae must from now onwards be regarded as true Odonata!*

With the Meganeuridae removed, the old Order Protodonata becomes a mere remnant of three genera—*Protagrion, Calvertiella and Tillyardiella.* Following on this, the question at once arises as to whether these remaining forms are really distinct enough from some of the forms placed within the Palaeodictyoptera to warrant the retention of the ordinal name. I think that a decision on this point cannot be made without a very full analysis of the characters of certain families of Palaeodictyptera and also a very complete study of all forms related to the Order Archodonata of Martynov, which includes only the genus *Palaeothemis* Mart. In particular, it would appear important that we should thoroughly understand the composition of the anal veins in all these forms and their relationship to the anal veins in the Plectopteroid complex, to which they are more or less distinctly allied.

In the present paper, I propose to include as true Odonata all those forms in which the two main veins MP and CuA are either entirely absent or else represented by small basal remnants. Under this system, the family Meganeuridae must take its place as the most primitive types yet known within the Order, and be classified as a Suborder of the Order Odonata, with the name Meganisoptera (= Order Meganisoptera Mart.).

It will, I trust, be fully understood that, as nearly all the fossil forms are known only from the wings, the characters used in defining the various groups which include fossils, must be drawn from the wing-venation. Undoubtedly if we had the fossil evidence preserved, other characters of great importance would be available, e.g. the amount of obliquity of the thorax, the number of tarsal segments, etc. But as matters stand, we must be thankful that the parts of an insect most generally preserved as fossils, viz., the wings and wing-venation, are just those which are of the greatest importance in the recognition of the various orders and families.

The following definitions will now serve to distinguish the Order Protodonata from the Order Odonata:—

Order PROTODONATA (Brongniart, emend. Handlirsch). (Fig. 3).

Palaeopterous insects having wings of Oodonatoid facies but retaining the archaic Palaeodictyopterous character of possessing a complete series of alternating convex and concave veins, including completely formed posterior media (MP), and completely formed anterior cubitus (CuA).

Suborder. 1. ARCHODONATA Martynov. Wings without a system of cross-veins; pterostigma present with the elongate subcosta passing through it; a pseudonodus formed on costa before halfway to apex. Anal system of veins resembling that of the Plectoptera,

with three convex anal veins, A1, A2, and A3, together with an intercalated concave anal vein, 1A, situated between A1 and A2.

Only a single family, Palaeothemidae Mart., with a single genus, *Palaeothemis* Mart. (Upper Permian, Russia).

Suborder 2. PALAEODONATA *nov. nom.* Wings with a complete system of cross-veins; pterostigma absent; subcosta extending well towards apex of wings; no nodal formation. Anal system of veins consisting of a single long convex anal vein, 1A, provided with a posteriorly placed, descending system of branches.

Only a single family, Protagriidae Mart., with three genera, *Protagrion* Brong. (Fig. 3). (Upper Carboniferous, France), *Calvertiella* Till. (Lower Permian, Kansas), and *Tillyardiella* Mart. (Upper Permian, Russia).

Order ODONATA Fabricius.

Palaeopterous insects in which the archaic Palaeodictyopterous characters of the wings are modified by the suppression of two of the main veins, viz., the concave posterior media, (MP), and the convex anterior cubitus, (CuA), which are usually entirely absent, though short basal remnants of one or both of these veins can still be found in a few of the older fossil forms. Anal system of veins consisting always of a single convex first anal (1A), which, in some narrow-winged or petiolate forms, is fused basally with CuP, or may even, in extreme cases (Archizygoptera) be entirely suppressed.

Key to the Suborders of the Order ODONATA.

1. Primitive forms with very narrow wings, petiolate or subpetiolate, having a short subcosta ending well before half-way to apex; no true nodus or discoidal cell .. .. 2.

 Not such forms .. .. 3.

2. Two or three antenodals present; postnodals few in number; a basal remnant of CuA present; subdiscoidal cell present; pterostigma present; number of cross-veins comparatively small .. .. PROTOZYGOPTERA Till.

 Antenodals absent; postnodals numerous; subcosta excessively short; no basal remnant of CuA present; no subdiscoidal cell; pterostigma present; number of cross-veins comparatively large. .. .. ARCHIZYGOPTERA Handl.

3. Large to very large Palaeozoic forms with the subcosta well developed, reaching from about half-way to near apex of wing; no true nodal formation; pterostigma absent; basal remnants of MP and CuA present or absent; CuP and 1A both sigmoidally waved in basal halves; no discoidal or subdiscoidal cell present. .. .. MEGANISOPTERA Mart.

 Not such forms. Pterostigma present in all save a few very highly specialized types (in which it becomes obsolete); sub-

costa never extending beyond two-thirds of the costa; nodus either completely or partly formed; either a discoidal or subdiscoidal cell always present .. .. 4.

4. Primitive Palaeozoic (possibly also Mesozoic) types with the subcosta ending more than half-way along the costa; nodal formation incomplete or complete; pterostigma present, extending well below R1; CuP and 1A both strongly arched upwards in region of arculus; no true discoidal cell present but a subdiscoidal cell always defined .. .. PROTANISOPTERA Carp.

   Not such forms. Discoidal cell always present although in the more primitive forms it may be open basally in both wings or forewing only .. .. 5.

5. Wings never petiolate; in both fore and hind wings the discoidal cell is subdivided into a triangle plus supratriangle. ANISOPTERA auct.

   Wings petiolate, subpetiolate or non-petiolate; discoidal cell either undivided, or, if divided into triangle plus supratriangle, then this formation is confined to the hind wing .. .. .. 6.

6. Discoidal cell of both wings simple, entire or traversed by nervures closely similar in fore and hind wings .. .. .. ZYGOPTERA auct.

   Discoidal cell differing in form in fore and hind wings; in the hind wing it may be either a single cell or divided into triangle plus supratriangle .. .. ANISOZYGOPTERA Handl.

Suborder I. MEGANISOPTERA Mart. (Figs. 4, 5.).

Order *Meganisoptera* Mart., 1932, Trav. Inst. Palaezool. Acad. Sci. URSS, 1:1-44, pl. i. (p. 17).

Handlirsch recognized two families, the Meganeuridae and Paralogidae, distinguished by the shape of the wing and the separation or union of the basal stems of R1 and Rs + MA. The discovery of a considerable number of intermediate forms since Handlirsch wrote has almost bridged the gap between his two families. I therefore propose to recognize only the one family Meganeuridae, with the following genera:—

Upper Carboniferous:—

European genera:—*Meganeura* Brong., *Meganeurella* Handl., *Meganeurina* Handl., *Meganeurites* Handl., *Boltonites* Handl., *Truemania* Bolton, *Ephemerites* Geinitz, *Gilsonia* Meunier.

North American genera:—*Palaeotherates* Handl., *Paralogus* Scudd., *Paralogopsis* Handl.

Permian:—

European genera:—*Arctotypus* Mart.

North American genera:—*Typus* Sell., *Megatypus* Till., *Oligotypus* Carp.

Mesozoic genera doubtfully belonging to this Suborder:—*Reisia* Handl., *Piroutetia* Meunier, *Schlectendaliola* Handl. ? (larval).

Suborder 2. **PROTOZYGOPTERA** Till. (Figs. 6, 8.).

Protozygoptera Tillyard, 1925, Amer. J. Sci., 10 (55): 41-73. (p. 62.).

This Suborder begins the very distinct series of forms which may be classified together under the term "Zygopteroid Complex". The earliest types are small forms with extremely narrow wings, having marked petiolation. The subcosta is always greatly shortened and never, even in the most highly specialized types within the Complex, reaches as far as halfway along the wing. The pterostigma is well formed in the oldest known types, being a narrow, elongate rectangle in form and not extending below R1; in the more highly evolved types within the Complex, many different types of pterostigma arise, and in one evolutionary line the pterostigma becomes at first obsolescent and then obsolete in a few genera. Nodal formation begins with a slight bend of the costa at end of Sc, followed by fixation of a cross-vein below this point and later by the addition of a subnodus, but there is no fixation of Riv + v below the subnodus as in the Anisopteroid Complex. The earliest types, probably in correlation with the petiolation of the wings, have CuP fused with 1A basally. The original sigmoidal arching of CuP, inherited from a common ancestor with the Meganisoptera, is retained in the region of the arculus, but at first there is no true discoidal cell present, only a single cross-vein situated between the downwardly bending portions of MA and CuP. This cross-vein (*dv*) later becomes oblique and forms the distal side of the discoidal cell or quadrilateral. A subdiscoidal cell (*sdc*) is present in the oldest forms, lying between the diverging veins CuP and 1A where they separate; this cell undergoes many vicissitudes in the higher forms. Generally speaking, the oldest forms possess the smallest number of cross-veins, with only two or at most three antenodals and very few postnodals. Two tendencies

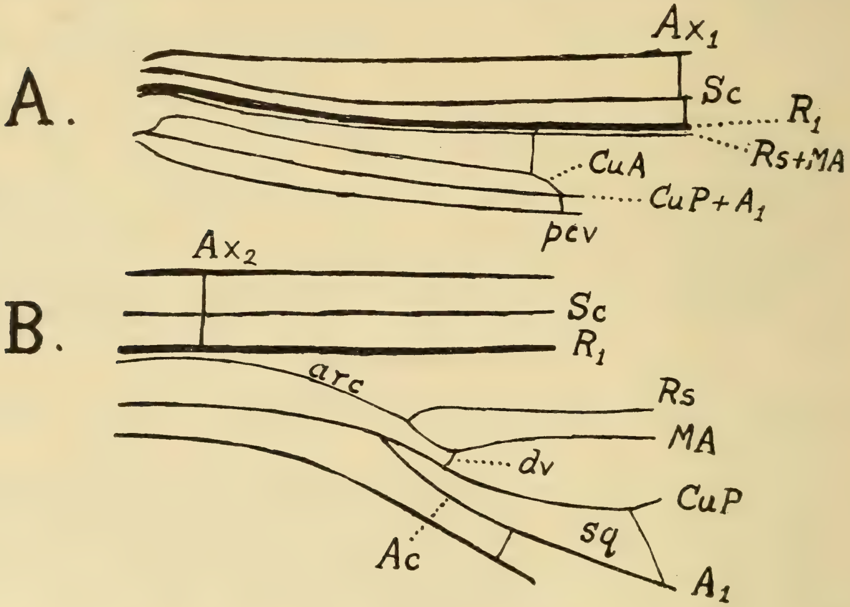


Fig. 9.

operate on the cross-vein system in the course of evolution: the first, leading to the Coenagrioidea, tends to arrange the existing cross-veins into transverse series; the second, leading to the Agrioidea, tends to increase the number of cross-veins greatly.

The Zygopteroid Complex, after throwing off an unsuccessful side-branch, the Archizygoptera, in early Mesozoic times, ran out into the highly successful Suborder Zygoptera as we know it to-day.

The principal characters of the wings of the Protozygoptera may be simply stated as follows:—

Wings very narrow, petiolate; usually only two, more rarely three antenodals; very few postnodals. *Sc* short, ending well before half-way to apex of wing. Nodus incomplete, merely a more or less marked indentation of the costa where Sc joins it, and with or without a nodal veinlet beneath it. Pterostigma well formed, strongly chitinized, narrow, elongate, rectangular in shape. A short but definitely convex basal remnant of CuA present in the basilar space, extending for less than half the length of the petiole. R and MA completely fused together basally; arculus formed by a donward divergence of Rs + MA from R1; shortly after it, Rs and MA again diverge and then run subparallel to one another. Rs is a concave vein with pectinate descending posterior branches, altogether five in number, of which three are concave original branches of Rs, viz., R2, R3, and R4 + 5, while two are intercalated convex veins, viz., 1R2 and 1R3. MA and CuP both end up on the posterior margin well beyond half-way to apex of wing but 1A may be either long or short.

Two families are represented, which may be distinguished as follows:—

No nodal veinlet aligned below end of SC; cross-veins few in all parts of the wing; 1A short .. .. KENNEDYIDAE Till.

A nodal veinlet aligned obliquely below end of Sc; cross-veins numerous in posterior part of wing; 1A moderately long .. .. PERMOLESTIDAE Mart.

The following genera are known:—

Family KENNEDYIDAE:—Lower Permian of Kansas—*Kennedya* Till., *Progoneura* Carp., *Opter* Sell.

Family PERMOLESTIDAE:—Lower Permian of Russia—*Permolestes* Mart.

ANNECTENT FORM:—The genus *Permolestes* Mart., might with almost equal justice be classified within the Zygoptera, but the presence of the short basal piece of CuA makes it more advisable to retain it within the Protozygoptera. It is well advanced beyond the stage shown in Kennedyidae, in the higher development of the nodus, the great increase in the development of the cross-vein system in all posterior parts of the wing, and in the longer and much more specialized 1A. In general appearance, the wing of *Permolestes* reminds one quite strongly of the Lestidae, but actually it serves in many ways to connect the Kennedyidae with the first known genus of true Zygoptera, viz.—*Permagrion* Till. (Upper Permian of the Falkland Islands) (Figs. 7, 8).

Suborder 3. ARCHIZYGOPTERA Handl. (Fig. 10.).

Archi-Zygoptera Handlirsch, 1908, Die Fossilen Insekten: 471.

(The name Archi-Zygoptera has here been altered to conform with the Rules.)

The Archizygoptera are a little known group of very curious forms which were evidently evolved from early types of Protozygoptera during the early part of the Mesozoic through further reduction of the veins Sc and 1A together with a large increase of the number of cross-veins distal to Sc, and the evolution of a highly specialized arrangement of the branches of

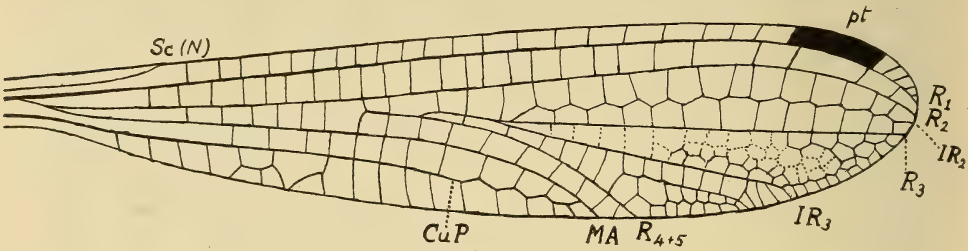


Fig. 10.

Rs. Unfortunately the wings are extremely delicate, so that, although a number of specimens are known from the Trias, Lias and Jurassic, it is still impossible to interpret the venation with absolute certainty.

The characters of the Suborder are as follows:—

Wings narrow, petiolate or subpetiolate. Sc reduced to a mere remnant, reaching less than one-fifth of the wing length along costa. No antenodals present, but numerous postnodals in the long space between the end of Sc and the rectangular pterostigma. Cross-veins abundant in all parts of the wing except near the base. No true nodus, and apparently, not even an indentation of the costa at the end of Sc. No sign of a discoidal cell or subdiscoidal cell and no discoidal cross-vein. The branches of Rs are very specialized, the intercalated veins 1R2 and 1R3 taking the form of straight intercalated sectors, and all the branches diverging from one another at extremely acute angles; between these branches, a polygonal mesh-work of cellules is beginning to form. A very marked character is the manner in which the two primary branches of Rs separate from one another; they diverge at an acute angle and then R4 + 5 arches strongly downwards *so as to be curved concavely to the posterior margin throughout its length.* At the same time, the apical portion of the wing is strengthened by the long intercalated vein 1R2 taking on the form of an absolutely straight vein running longitudinally through the wing and apparently joining R3 basally, while the latter vein also becomes a strong, straight vein running obliquely to well below the apex. 1R3 is a short, straight intercalated vein lying just below and parallel to R3. MA and CuP are well formed veins extending, as in Protozygoptera, well beyond half-way along the posterior margin of wing; but 1A appears to be either completely lost, or only represented by a short series of zigzagged veinlets below CuP.

There is only one family, the Protomyrmeleontidae, containing the following genera:—

Triassic (Australia):—*Triassagrion* Till.

Liassic to Jurassic (Europe and Asia):—*Protomyrmeleon* Geinitz, *Tillyardagrion* Mart.

Suborder 4. ZYGOPTERA auct. (Figs. 11, 12, 15-27.).

In this immense Suborder, beginning in the Upper Permian and extending to the present day are included all those types of damsel-flies in which a definite *discoidal cell* is formed below the arculus. For purposes of

classification, this cell may be either *open* or *closed* basally, that is to say, the formation of the cell is reckoned not from the time that it becomes closed-in basally by the provision of an extra cross-vein to form its basal side, but from the time when, through the oblique alignment of the original discoidal cross-vein (*dv*) with the basal free piece of Rs and MA above it, a complete *arculus formation* is provided connecting R with CuP. The *discoidal cell* or *quadrangle* (*q*) is then defined as the space between the oblique basal portion of MA above and the curving portion of CuP below; its distal side, *dv*, tends in the oldest types to extend the line of the basal portion of MA, but later on takes on greater individuality, when the discoidal cell becomes closed basally by an extra cross-vein.

That this is the only logical way to consider the discoidal cell must be evident when we study primitive living forms as *Hemiphlebia* and *Chorismagrion*, in which the two stages of evolution of this cell are exhibited in a single insect. In the forewings of these two genera, the discoidal cell remains open and keeps the primitive form found in the Permian genus *Permagrion* Till., but in the hind wings, the same cell is closed and forms a typical quadrilateral.

It should be noted that, as only a single wing of the Permian age is known, it cannot be stated definitely that this form possessed open discoidal cells in both fore and hind wings. It is indeed quite possible that this Permian wing represents a fore wing. At any rate, until more is known about it, the Permian genus cannot be given anything more than family rank within the Suborder Zygoptera.

Amongst the immense number of genera belonging to the Zygoptera, the venational characters are so diverse that a definition of the Suborder must rest mainly on the structure of the discoidal cell, other characters taking only secondary place. The Suborder may then be defined as follows:—

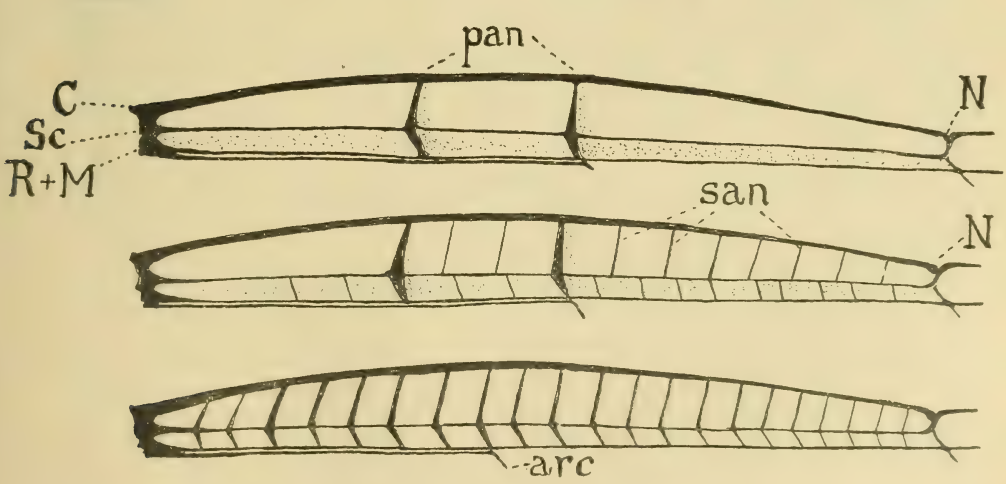


Fig. 11.

More or less delicately built dragonflies (damselflies) with fore and hind wings closely similar in size, shape and venation, slender to moderately wide wings, petiolate, subpetiolate or non-petiolate, but never greatly

widened near base. Sc always ending before half-way along costa. Nodus always partly or wholly formed, the most primitive type (Permian) having a marked indentation of the costa at end of Sc, with an imperfect alignment of the nodal veinlet (*nv*) and subnodus (*sn*) below it; in all higher types, the nodus is complete. Antenodals originally only two or three, but becoming numerous in higher types. Postnodals originally very few, but increasing in number in higher types. Pterostigma originally rhomboidal or rectangular, but varying greatly in form in the higher types; in a few genera, it may even be obsolete. Rs with three primary (concave) and two intercalated (convex) branches, as in the Protozygoptera, but many additional intercalated sectors may be present in some of the higher forms. Discoidal cell or quadrilateral similar in fore and hindwings, open basally in a few primitive forms only (in forewings only of two genera, *Hemiphlebia* and *Chorismagrion*) ; this cell may be simple or crossed, but is never subdivided into triangle plus supra-triangle as in the Anisoptera or hindwings of some Anisozygoptera. CuP and 1A of variable length; in some forms, both these veins are shortened, and 1A may even be entirely suppressed (as in Archizygoptera).

With the discovery of new types, including a Permian and some incomplete Triassic genera, the task of tracing out the evolutionary line within the Zygoptera is becoming a very formidable one. Nevertheless, it is now clear that it would have been quite impossible to offer a phylogenetically accurate classification of the Suborder without the knowledge of these new genera, even though we may well suspect that, with our present knowledge, any classification that may be offered, will be sure to undergo further changes.

The classical method of subdividing the Zygoptera is into two groups (originally families, in the Selysian sense), according to the number of antenodals present. In the Superfamily Coenagrioidea (family Agrioidea of Selys et auct.) there are usually only two antenodals, very rarely from three to five. Any additional or secondary antenodals are incomplete and found only in the costal space. In the Superfamily Agrioidea (family Calopterygidae of Selys *et auct*) the antenodals are numerous, the lowest number being five, and there are always more than two which occupy both costal and subcostal spaces.

It will be seen that, if this classification were to be accepted, the Permian genus *Permagrion* Till., would fall within the Coenagriidae, as would also the genera *Hemiphlebia* and *Chorismagrion* in both of which the discoidal cell of the forewing is open basally.

Admittedly these three genera are all very archaic. But, in my opinion, *Hemiphlebia* is the most archaic of the three, for the following reasons:—

(1) The second (distal) antenodal stands well before the level of the arculus. This agrees with the condition found in the Protozygoptera. In all other true Zygoptera possessing two antenodals, even including *Permagrion*, the second antenodal is either directly above the origin of the arculus or extremely close to it (vii).

(vii) This statement is not quite correct, since in several genera of the Coenagriidae, the arculus stands well distal to the level of the distal primary antenodal, viz., *Agriocnemis, Argiocnemis,* etc. In some species of *Cephalaeschna* the arculus also occupies a position comparable to that found in *Hemiphlebia*.—Fraser.

(2) Only occasionally do the postnodals in *Hemiphlebia* line up with those cross-veins in the space immediately adjoining them. In this character, *Hemiphlebia* agrees with the Agrioidea, but disagrees with all other Coenagrioidea, inclusive of *Permagrion*.

(3) The posterior margin of the wing in *Hemiphlebia* if followed back beyond the anal crossing (*Ac*) towards the base, can be seen to be composed of two contiguous but distinct veins, viz., the true anal vein, 1A, placed anteriorly, and the posterior margin, which resembles the costa in being armed with distinct serrations, though these are weaker and placed more widely apart than on the costa. In this character also the genus *Hemiphlebia* resembles the Agrioidea and differs from all other Coenagrioidea, including even *Permagrion* (not to mention also the Protozygoptera), in which the posterior margin of the wing up to the anal crossing is a simple chitinization. (See footnote (v) and text-fig. 13.)

I had previously (1926) explained this important character by supposing that *a secondary anal vein* was in process of formation backwards towards the base of wing from Ac, and that *Hemiphlebia* exhibited the first stage of this formation. This explanation follows immediately on the acceptance of the precedent tracheation as a guide to the subsequent venation. But I am now inclined to agree with Carpenter (1931, p. 112) that the tracheation may be as unreliable in this case as I had previously shown it to be in the case of the supposed crossing-over of Rs in the Anisoptera. In that case, *Hemiphlebia* is again seen to stand at the very base of the Agrioidea rather than of the Coenagrioidea (viii).

(4) The discovery of the larva of *Hemiphlebia* (Tillyard, 1928) shows that it is a far more primitive type than any other known larva.

I therefore propose to separate *Hemiphlebia* out, not merely as a distinct family, as I did in 1926, but as a superfamily of its own standing at the very base of the whole Suborder, and combining certain characters of both the other two superfamilies. It agrees with the Coenagrioidea in possessing only two antenodals and generally in the simplicity of its venation, but it also agrees with the Agrioidea in having no alignment of the postnodals with those cross-nervures in the adjacent space posteriorly, and also in the presence of the anal vein, distinct from the posterior margin basally from the anal crossing, Ac.

The following key will now separate out the three superfamilies into which I propose to subdivide the Zygoptera:—

1. Distance from base of wing to arculus either greater than distance from arculus to nodus, or, at the least, equal to it. Antenodals normally two only, rarely from three to five, in which case the additional ones are incomplete (except in *Neurolestes*, which has three complete antenodals). Discoidal cell entire (crossed only in *Anomisma*), always a closed quadrilateral except in some early fossil

---

(viii) I am not inclined to share Dr. Tillyard's or Professor Carpenter's opinion in this, since it still leaves us with the nervure Ac to account for. This is present in *Hemiphlebia* and can be followed right through the whole Order, occupying the same position. If only a simple cross-nervure, surely we should expect to find some variation in its position? Its constancy stamps it as a vestigial structure and no other explanation but that it is the site of the crossing-over of the nervure 1A will meet the case. In Part II. of this paper, I shall endeavour to show by means of diagrams that Dr. Tillyard's first supposition was the correct one.—Fraser.

forms and in the forewings of *Hemiphlebia* and *Chorismagrion*, where it is open basally .. .. 2.
Distance from base of wing to arculus always less than distance from arculus to nodus, usually much less (in *Disparocypha* only slightly less). Antenodals always more than two, never less than five; discoidal cell nearly always crossed (entire only in *Disparocypha*, *Philoganga*, *Amphipteryx* and *Diphlebia*), never open basally .. .. Superfamily AGRIOIDEA Till.

2. Postnodals of first and second series not aligned with one another. Anal vein visible as a separate vein from base of wing outwards, contiguous with the posterior margin up to Ac .. .. Superfamily HEMIPHLEBIOIDEA Till.
Postnodals of first and second series aligned with one another, either wholly or in part. No sign of a separate vein from base of wing to Ac .. .. Superfamily COENAGRIODEA Till.

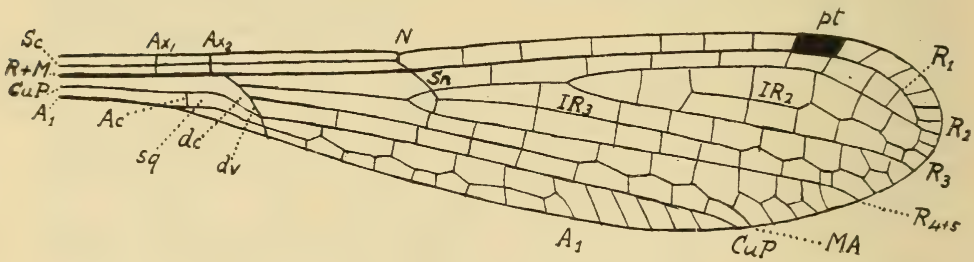


Fig. 12.

Superfamily HEMIPHLEBIOIDEA Tillyard. (Figs. 12, 13.)

Antenodals two in number only, of which the distal one is situated proximal to the level of the arculus; no alignment of any postnodals with cross-nervures posterior to themselves; discoidal cell of forewing open, that of hindwing closed; subdiscoidal cell fully formed; anal vein partly fused with posterior margin of wing basally, but separating from it just before the anal crossing (Ac) which forms the basal side of the subquadrangle.

Family HEMIPHLEBIIDAE Tillyard.

There is only one family, the Hemiphlebiidae, containing a single genus, *Hemiphlebia* Selys, with a single species, *H. mirabilis* Selys, confined, so far as is at present known, to a single habitat on the Goulburn River, near Alexandra Victoria, Australia (ix).

(ix) The types of this species are stated by Selys to have come from Port Denison, Queensland (received from M. Weyers), and the same locality is given for types of *Synlestes weyersi* Selys. Having recently visited Bowen (Port Denison), North Queensland and explored the country all round it, I can say with certainty that neither of these two species can possibly have occurred anywhere in that region; firstly because there is no suitable type of fresh-water for their larvae to exist in, and, secondly, because the region is a dry one, subject to prolonged drought almost yearly. The species *Synlestes weyersi* is abundant in suitable localities in Victoria, New South Wales and South Queensland, but has not been taken further north than

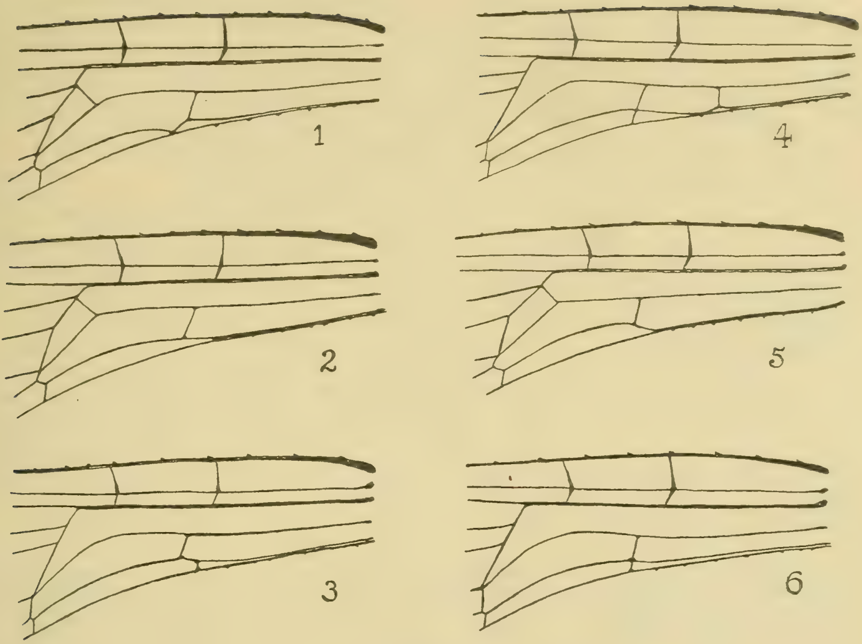


Fig. 13.

To the superfamily characters may be added the following as of only family or generic value:—

Size very small; abdomen very slender, extending beyond the wings; petiolation of wings not clearly marked off by an indentation or angulation of posterior margin of wing; postnodals 5-6 in number, only normally 4 in the space posterior tc them; pterostigma short, rhomboidal, covering a single cell; veins 1R2 and 1R3, together with some distal cross-veins, distinctly hairy. In forewing, there is a single oblique line formed between R and 1A by the following elements—(a) upper portion of arculus, (b) distal side of the open discoidal cell, (c) short distal side of subdiscoidal cell. In both wings, the anal-crossing, (Ac) is to be interpreted as *a mere cross-vein* impinging upon the vein 1A just after it leaves the posterior margin. A study of the tracheation of the nymphal wing indicates that at no time is any trachea present, and therefore this cross-vein cannot very well represent the previous crossing-over of such a trachea from the line of CuP to the posterior margin. It might, however, be interpreted as the homologue of the cross-vein which, in *Kennedya* and *Permolestes*, supports the downturned end of the primitive basal remnant of CuA from below.

For a full understanding of the importance of the genus *Hemiphlebia*

---

the Blackall Ranges, approximately 100 miles north of Brisbane. I have searched very large areas of suitable country in Eastern Australia for *Hemiphlebia* without success, except for the original locality discovered many years ago by Captain Billinghurst and recorded by Rene Martin (1904).—Tillyard.

in any scheme of classification of the Zygoptera, it would be necessary to give a much more complete account of the insect, enumerating not only its venational peculiarities, but also the many archaic characters to be found in its head, thorax, abdomen and anal appendages, in the remarkably archaic larva or nymph and in the tracheation of the nymphal wings. These however, are outside the scope of the present paper.

Superfamily 2. COENAGRIODEA Tillyard (emend.) (Figs. 14-27.).

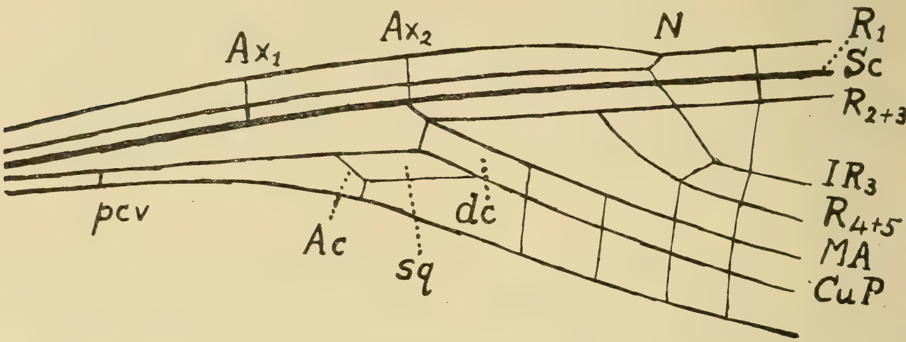


Fig. 14.

Antenodals only two in number, very rarely three, four or five, in which cases the additional ones are found only in the costal space; distal antenodal situated directly above and in line with the arculus or the arculus situated slightly distal to it; postnodals usually corresponding with the cross-nervures in the space posterior to themselves, except for the distal one or two; at the least, the more proximal postnodals are aligned, though the distal ones may not be (e.g., *Argia*). Pterostigma variable in form, always present and in some cases hypertrophied. Discoidal cell (dc or q) complete in every case except only in the forewing of genus *Chorismagrion* (Synlestidae) and in the only known wing of the Permian genus *Permagrion,* which may also be a forewing. Originally all the branches of Rs arose distal to the nodus, as in *Permagrion*; in the course of evolution, the origins of these branches have tended to move basally, until, at the present day, only a few primitive genera retain this condition; in the great majority of forms, either the origin of R4 + 5 is in line with the subnodus, or that of 1R3 is in line with it and that of R4 + 5 is slightly proximal to it, or both these veins have moved well proximal to the level of the subnodus. The subdiscoidal cell either completely formed not touching the posterior margin, or meeting it at a point, or completely eliminated. Veins CuP and 1A either both long and complete, or one or both of them reduced or completely eliminated. Additional intercalated sectors sometimes present; in extreme cases, these occur distally between all main veins from R1 to 1A.

The following key will serve to distinguish the known families of the Coenagrioidea:—

1. Discoidal cell open basally; nodal vein (*nv*) and subnodus (*sn*) situated in an oblique line markedly before the level of Sc, that is Sc extends distal to the line of *nv* . . . . PERMAGRIIDAE Till.
   Discoidal cell closed basally (except in the forewing of *Chorismagrion*); nodal vein and subnodus in an oblique line situated at the level of the distal end of Sc. . . . . 2.

2. CuP arching strongly upwards on leaving the discoidal cell .. .. SYNLESTIDAE Till.
CuP not arched strongly at this point .. .. 3.

3. R4 + 5 and 1R3 both arising far proximal to the level of subnodus, 1R3 usually at least half-way between arculus and subnodus and usually nearer the arculus .. .. 4.
R4 + 5 and 1R3 arising nearer the subnodus than arculus; at the most, R4 + 5 arising half-way between arculus and subnodus .. .. 5.

4. Veins CuP and 1A complete; supplementary sectors present between 1R3, R4 + 5 and MA .. .. LESTIDAE auct.
Vein CuP greatly reduced, vein 1A entirely absent; two straight supplementary sectors present, one between R2 and 1R2 and another between 1R2 and R3 .. .. LESTOIDEIDAE Till.

5. Nodus situated very close to base of wing, at from one-sixth to one-fourth the wing-length; pterostigma absent, or if present, abnormal, not fully chitinized, or made up of several cells, never braced .. .. PSEUDOSTIGMATIDAE auct.
Nodus lying more distal, usually more than one-fourth the wing-length from base (if nearer, then the pterostigma normal); pterostigma present, strongly chitinized (rarely hypertrophied), braced or unbraced .. .. 6.

6. Supplementary sectors present distally and extending proximal as far as the level of pterostigma or further .. .. MEGAPODAGRIIDAE Till.
Supplementary sectors absent or at most a few distal cellules aligned and not extending proximal as far as pterostigma .. .. 7.

7. Vein 1A absent or greatly reduced; vein CuP normal or reduced .. .. 8.
Veins CuP and 1A normal .. .. 9.

8. An extra cross-vein present in the postcostal space, very close to base of wing and in addition to that of the anal-crossing (Ac); number of postnodals comparatively large .. PLATYSTICTIDAE Fraser.
No additional cross-vein in the postcostal space; number of postnodals comparatively small .. .. PROTONEURIDAE Till.

9. Discoidal cell subrectangular; no marked zig-zagging of any of the main veins (only distal portion of MA slightly zig-zagged) .. .. PLATYCNEMIDIDAE Till.
Discoidal cell with distal angle markedly acute; veins 1R3, MA and 1A strongly zig-zagged distally .. .. COENAGRIIDAE Till.

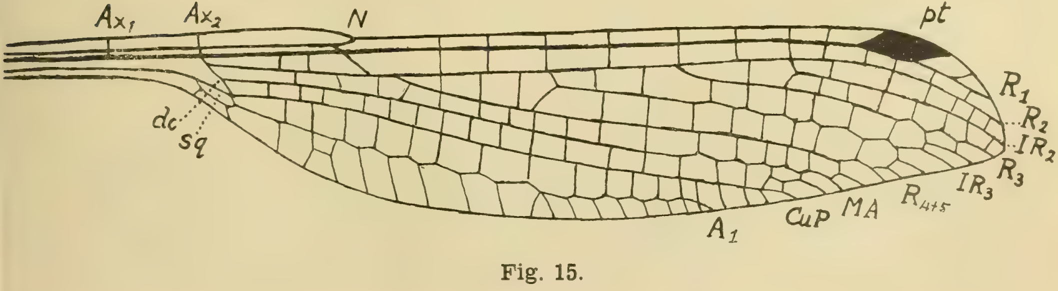


Fig. 15.

Family I. PERMAGRIIDAE Tillyard. (Figs. 7, 15.).
Permagriidae Till., 1928, Trans. Roy. Ent. Soc. Lond., 1: 56.

The single wing from the Upper Permian of the Falkland Islands forms a connecting link between the Lower Permian Kennedyidae (Suborder Protozygoptera) and recent Zygoptera. Though *Permagrion falklandicum* is probably not ancestral to any existing form, it obviously lies fairly close to the ancestors of the Synlestidae, especially *Chorismagrion.* From all known Zygoptera of later geological dates, it differs in the less complete formation of the nodus, in which the nodal vein and subnodus have not yet become as closely aligned with the tip of Sc as in other forms. In this and some other respects it stands at nearly the same level as *Permolestes,* but it is well in advance of the latter in the complete loss of the primitive basal remnant of CuA, and must therefore be placed within the true Zygoptera.

Its venational characters are as follows:—Antenodals two in number only, the distal in line with the arculus; postnodals eight in number, all coinciding with the cross-nervures immediately beneath them; apex of wing somewhat falcate; pterostigma rhomboidal, covering two cells; no alignment of cross-veins into transverse rows in distal part of wing below R2. All branches of Rs arising distal to subnodus; R4 + 5 arising slightly distal to subnodus, barely one cell's length, the other three branches at nearly equal intervals apart; 1R3 four cells distal from R4 + 5; R3 three cells distal to 1R3, and 1R2 two cells distal to R3; 1R3, MA and 1A slightly zig-zagged in their distal portions, the other veins straight; discoidal cell open basally, its distal angle acute, its distal side practically in line with the arculus; subdiscoidal cell (sq) completely formed by closure of the first cell between CuP and 1A after they separate, the distal side being formed by a strong oblique cross-vein descending from the distal side of discoidal cell. Only a slight upward arching of CuP after leaving the discoidal cell. The space between the middle of 1A and the posterior margin of wing rather wide.

Only a single genus is known, *Permagrion* Till., from the Upper Permian of the Falkland Islands.

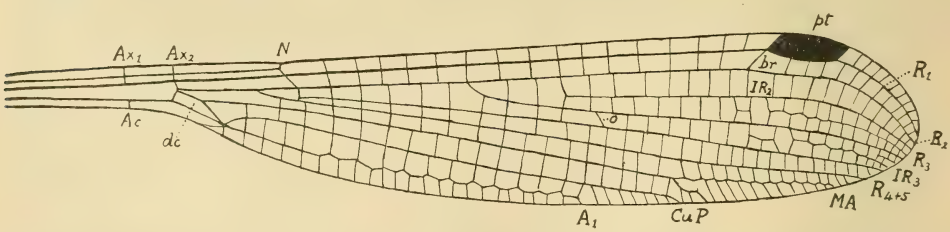


Fig. 16.

Family 2. SYNLESTIDAE Tillyard. (Figs. 16, 17.).
Synlestidae Till., 1926, Insects of Australia and New Zealand, 78.

This family can be at once recognized by the marked upward arching of CuP after leaving the distal angle of the discoidal cell. This character which is, of course, the remnant of the original sigmoidal curvature of this vein, so evident in the Meganisoptera and Protanisoptera, is a very primitive one, derived without change from the Protozygopterous Kennedyidae, in which the same upward arching is clearly to be seen though there is as

yet no true discoidal cell. (Compare figures 4 and 5 with figures 16 and 17.).

The venational characters are as follows:—Discoidal cell with the distal angle more or less acute (in *Perilestes,* its apex is buried in the posterior margin of the wing). Nodus at from one-quarter to one-third of the wing-length from the base; origins of R4 + 5 and 1R3 variable. (*Perilestes* is exceptional in retaining the archaic condition seen in the Permagriidae, in which all the branches of Rs arise well distal to the subnodus.) Pterostigma rectangular or rhomboidal, often with posterior side somewhat swollen into the space below R1; brace vein weak or absent. Supplementary sectors absent or present; formation of transverse arrangements of cross-veins in that part of the wing beyond level of nodus only poorly or partially accomplished; an oblique vein present or absent between R3 and 1R3. Superior anal appendages of male always forcipate.

The final court of appeal to determine whether any particular genus does or does not belong to this family must, I think, lie in the remarkable larval form, in which the labial mask has a prominent cleft median lobe, lateral lobe with two internal teeth only, and no setae either on lateral lobe or movable hooks. Next to the mask of *Hemiphlebia,* this is the most primitive type of Zygopterous mask known. I have recently discovered the larva of *Chorismagrion* in North Queensland and find that it conforms closely to this type also.

This family may be divided into four subfamilies, as follows:—

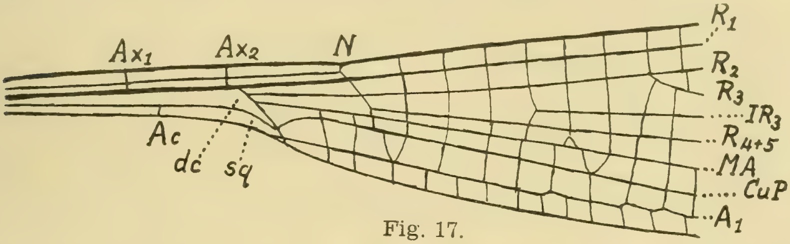


Fig. 17.

Subfamily 1. CHORISMAGRIINAE nov. subfam. Forewing with discoidal cell open basally; all branches of Rs arising well distal to level of subnodus except R4 + 5, which arises at that level.

Only one genus, *Chorismagrion* Morton (Australian).

Subfamily 2. PERILESTINAE nov. subfam. Both wings with discoidal cell closed basally but its distal angle impinging on the posterior border of wing; all branches of Rs arising distal to the level of subnodus.

Only one genus, *Perilestes* Selys. (Neotropical).

Subfamily 3. SYNLESTINAE Tillyard. Both wings with discoidal cell closed basally but the distal angle of cell not extending to wing margin; 1R3 and R4 + 5 arising nearer to subnodus than to arculus.

Two genera, *Synlestes* Selys. (Australian), *Chlorolestes* Selys. (Ethiopian).

Subfamily 4. MEGALESTINAE nov. subfam. Wings as in the Synlestinae except that 1R3 and R4 + 5 both arise nearer to the arculus than to the subnodus.

Two genera, both Oriental, *Megalestes* Selys., *Orolestes* McLachlan.

Annectent forms:—The Megalestinae may be considered, from the venational standpoint only, as annectent to the Lestidae, the corresponding annectent within the Lestidae being the genus *Archilestes,* in which there still remains some indication of the arching of CuP from the distal angle of the discoidal cell. But the very marked differences between the larval characters in the two families Synlestidae and Lestidae seem to indicate that the annectency is not complete—a condition which might easily also be true in supposed fossil annectents, of which we do not know the larval forms.

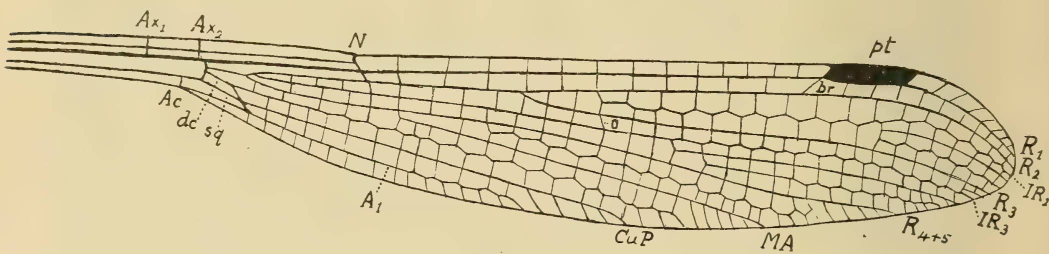


Fig. 18.

Family 3. Lestidae auct. (Fig. 18.).

The principal venational characters in this family are the positions of origins of 1R3 and R4 + 5, which both arise much nearer to the arculus than to the nodus, combined with the absence of the principal character found in the Synlestidae, viz., the arching upwards of CuP on leaving the discoidal cell. Most definitions stress the form of the quadrilateral, owing to the fact that, in most of the genera, it is of a characteristic form, with its distal angle very acute and its anterior side much shorter than its posterior one. But this is not true of all the genera, and actually serves, in the present classification, to subdivide the family into two well marked subfamilies.

An oblique vein is invariably present between R3 and 1R3 due to a fixation of a secondary character in the larval wing tracheation.

Of equal importance is the remarkable form of the labial mask of the larva, in which the teeth on the inner margin of the lateral lobe are very large and setae are present both on the lobe itself and the movable hook. The caudal gills are also very characteristic, being very long and with the lateral tracheae placed at right angles to the main tracheal trunks.

In general, the wings of Lestidae are characterized by a considerable lack of alignment of cross-veins transversely across the wing, compared with most other Zygopterid types. This is due to the zigzagging of 1R2 and of the distal portion or even the whole of MA, together with the zigzagging of some of the intercalated sectors, which are present around the distal margin of the wing and more especially between 1R3, R4 + 5 and MA. The pterostigma is always much longer than wide; the subnodal cell is always either completely free from the posterior margin or else merely touches it at its basal posterior angle.

As in the preceding family, the superior appendages in the males are always forcipate.

Two subfamilies can be recognized as follows:—

Subfamily 1. Hypolestinae nov. subfam. Quadrilateral not markedly

acutely angled, its costal side always more than half as long as its posterior side. Pterostigma unbraced.

Only two genera, *Hypolestes* Gund., *Pseudolestes* Kirby, neotropical and Oriental respectively.

Subfamily 2. LESTINAE auct. Quadrilateral acutely angled distally, its anterior side always less than one half the length of posterior side. Pterostigma well braced. Numerous genera are known— *Australestes* Till. (Australian), *Africalestes* Kenn. (Ethiopian), *Archilestes* Selys, *Superlestes* Will., *Cyptolestes* Will. (American), *Platylestes* Selys, *Ceylonolestes* Kenn., *Indolestes* Fraser (Oriental), *Sympecma* Charp. (Eurasian), and *Lestes* Leach (Cosmopolitan).

The Hypolestes are somewhat venationally annectent to the Megapodagriidae. *Archilestes,* as has already been mentioned under the Synlestidae, is venationally annectent to that family. The family Lestidae includes an interesting series of forms with respect to the manner of holding the wings at rest, the more archaic types resting with the wings half-open, the more specialized types with the wings closed.

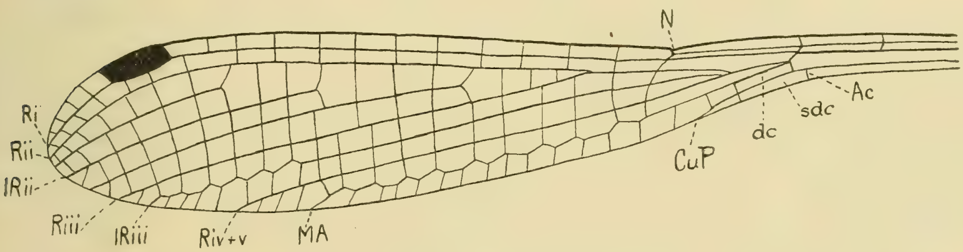


Fig. 19.—*Lestoidea conjuncta* Till.

Family 4. LESTOIDEIDAE nov. fam. (Fig. 19.).

Subfam. *Lestoidinae* Munz, 1919, Mem. Amer. Ent. Soc. 3: 17.

This family is proposed for a very remarkable genus, *Lestoidea,* discovered by myself in North Queensland. In it, CuP is reduced to a single cell's length; 1A is entirely absent; 1R3 and R4 + 5 arise together about midway between the arculus and subnodus. Distal to the level of the subnodus, there appear to be four evenly-spaced branches of Rs; of these, the first (most proximal) is obviously R3, the third is almost certainly 1R2, while the second and fourth appear to be two intercalated sectors which have lost their original zigzagging and have become straightened so as to resemble branches of main veins. The only zigzagged veins are the distal

(x) Mr. J. Cowley has pointed out to me that the penile organ of *Pseudolestes* has not the characters of a Lestine one, and that, for this reason, it would be advisable to retain the genus in the Megapodagriidae, an opinion to which I fully subscribe. Again in the case of *Hypolestes,* Kennedy has pointed out that the penile organ has no Lestine characters and closely resembles that of the Amphipteryginae, whilst the larvae resemble those of the Megapodagriidae. In the face of such facts, it seems better to remove these two genera to the Megapodagriidae, and to include only the subfamily Lestinae in the family Lestidae. In the original MS, Dr. Tillyard gives *Ortholestes* Calv., instead of *Hypolestes* Gundlach. Had he had the knowledge of this synonymy, I doubt if he would have suggested such a division of the Lestidae.—Fraser.

third of 1R3 and the greater portion of MA. The pterostigma is considerably longer than wide; discoidal cell an elongate rectangle. The superior anal appendages of the male are forcipate.

Only a single genus, *Lestoidea* Till.

This peculiar form combines the characters found in three different families. The great reduction of the main veins CuP and 1A is reminiscent of the Protoneuridae, the positions of the origins of 1R3 and R4 + 5 resemble those in the Lestidae, and the presence of straight intercalated sectors between R2, 1R2 and R3 reminds one of the Megapodagriidae. *Lestoidea*, however, differs from all known Megapodagriidae, and indeed, from all other Zygoptera, in that these intercalated sectors are carried right through from the wing border to the main stem of R2, so that they exactly resemble in their structure, the vein 1R2 itself.

Family 5. PSEUDOSTIGMATIDAE nov. fam. (Fig. 20.).

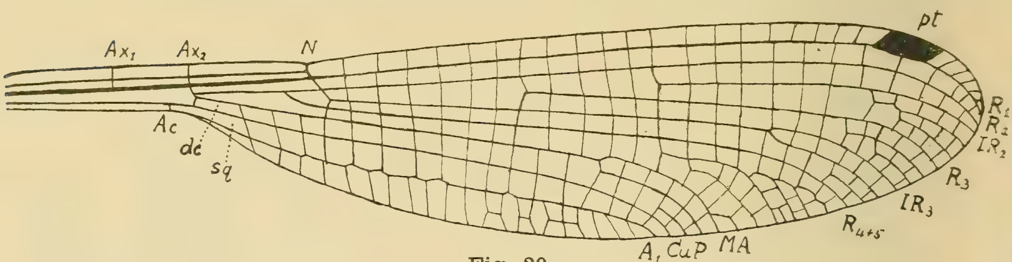


Fig. 20.

Division *Pseudostigmatina* Kirby, 1890, p. 119.

Subfamily *Pseudostigmatinae* Munz, 1919, Mem. Amer. Ent. Soc. 3: 20.

This peculiar and, in some respects, aberrant group can be easily recognized by three important venational characters, viz. (1) the nodus is placed very close to the wing base, i.e., from one-fifth to one-sixth of the total length of the wing (c.f., however *Thaumatoneura*, an annectent genus between this family and the Megapodagriidae), (2) there is an enormous increase in the number of postnodals and generally in the cross-vein system of the whole wing distally from the nodus, and (3) the pterostigma is either absent or extremely aberrant in form, ranging from a group of darkened but not particularly chitinized cells (*Mecistogaster, Megaloprepus*) down to a single minute cell in *Microstigma*, and a complete loss of the structure in *Anomisma*.

Other venational characters are:—1R3 arising at the subnodus, R4 + 5 a little before it; 1R2 arising from two to six cells distal to R3; no intercalated sectors present except between R2 and 1R2; discoidal cell simple or crossed, elongate, with the distal angle more or less acute but not markedly so (anterior side always considerably more than half as long as the posterior); veins CuP and 1A always very long, ending up well beyond halfway to apex of wing along the posterior border.

The male appendages are variable in form. The larvae live in water collected at the bases of leaves and bracts of epiphytic Bromeliads in Central and South America; in correlation with this habitat, to allow of their insertion into these deep and cleft-like receptacles, the abdomens of the imagos are greatly elongated.

Genera:—*Mecistogaster* Ramb., *Pseudostigma* Selys, *Microstigma* Ramb., *Anomisma* McLach., *Megaloprepus* Ramb. (xi).

Annectent form:—The family Pseudostigmatidae would appear as a very isolated group in any scheme of classification were it not for the existence of the genus *Thaumatoneura* McLach., here placed in the family Megapodagriidae, but undoubtedly an annectent form connecting the latter with the Pseudostigmatidae. Calvert (1915) has shown that the larva of this genus is a waterfall dweller, and it seems possible that the change from a normal aquatic existence to one in water collected at the base of the leaves of epiphytic Bromeliads, may originally have been accomplished by way of waterfall dwelling? *Thaumatoneura* agrees with the Pseudostigmatidae in the proximity of the nodus to the wing-base and the correlated immense development of postnodals and of the cross-veins in general, distal to the level of the arculus; it agrees with the Megapodagriidae in possessing a well formed, normal pterostigma and in the strong development of intercalated sectors.

While agreeing with Calvert in placing this form definitely within the family Megapodagriidae, I consider it so aberrant in a number of characters that I have no hesitation in forming a separate subfamily for it.

Family 6. MEGAPODAGRIIDAE Till. (Figs. 21, 22.).

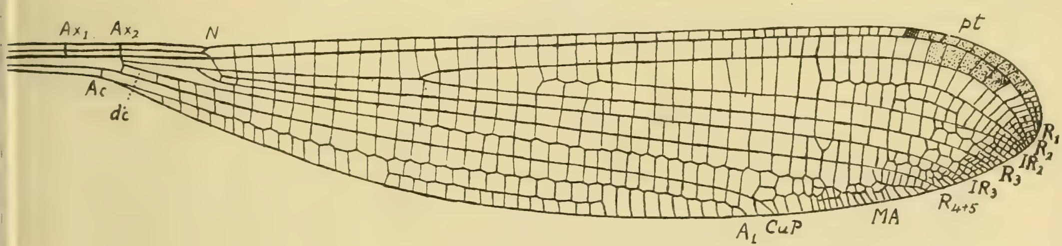


Fig. 21.

This family can be recognized at once by the following combination of characters:—Superior appendages of male forcipate; wings held either open widely or partly so when at rest; venation with a greater or less development of intercalated sectors; R4 + 5 never arising nearer the arculus than to subnodus (equidistant in *Rhipidolestes,* much nearer the subnodus in all other genera); discoidal cell always an elongated quadrilateral, its distal angle varying from acute (*Rhinagrion, Megapodagrion*) to subacute in most genera, rectangular in *Thaumatoneura*; 1R2 arising from two to four cells distal to R3; pterostigma always complete, variable in shape but usually longer than wide; anal bridge variable, the subdiscoidal cell being either quite separate from the posterior margin of wing or just touching it at the anal crossing, or having its posterior side (the anal bridge) partly or almost wholly fused with that margin; additional antenodals in costal space occasionally present.

Pending the discovery of many unknown larvae in this family, it would

(xi) Kennedy has further split up the genera of this family by characters of the penes, and has created the following extra genera:—*Xanthostigma* Kenn., *Goniostigma* Kenn., *Platystigma* Kenn., and *Haplostigma* Kenn.

appear wisest to abandon any attempt to divide it into subfamilies and, for the present, I shall be content with merely separating *Thaumatoneura* as a distinct subfamily by itself, leaving all the remaining genera in the subfamily Megapodagriinae.

Subfamily THAUMATONEURINAE nov. subfam. (Fig. 22.).

Nodus placed very close to wing-base, at about one-sixth of the length of the wing. Antenodals four to five in number, of which all but the original two are in the costal space only; postnodals extremely numerous; discoidal cell a rectangle; petiole very short. Very great development of arched intercalated sectors along posterior margin of wing; space between 1A and posterior margin very wide distally and with numerous arching branches descending from 1A.

Only one genus, *Thaumatoneura* McLach.

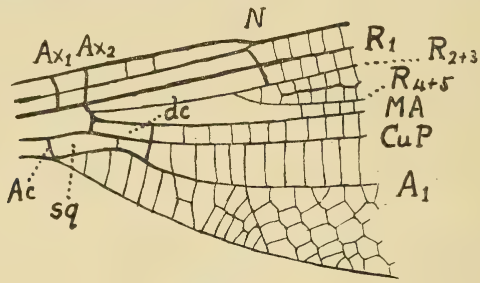


Fig. 22.

Subfamily MEGAPODAGRIINAE McLachlan. (Fig. 21.).

Nodus placed at from one-fourth to one-third the length of wing from base; usually only two antenodals but an additional one may be present in some living genera and as many as three additionals in the costal space, in some Tertiary genera. Postnodals moderately numerous only; discoidal cell always with the distal angle more or less acute, never an actual rectangle; no marked development of arched intercalated sectors along the posterior margin of wing; space between 1A and the wing border either narrow distally (one cell wide) or at most only moderately wide.

Genera with more than two antenodals:—*Dysagrion* Scudd. (Eocene), *Phenacolestes* Cock. (Miocene), *Neurolestes* Selys. (Recent), *Neuragrion* Karsch. (Recent), *Trineuragrion* Ris. (Recent), *Stenolestes* Scudd. (Miocene).

Genera with only two antenodals (all recent except *Melanagrion* and *Lithagrion*):—*Melanagrion* Cock. (Miocene), *Lithagrion* Scudd. (Miocene), *Rhinagrion* Calv., *Rhipidolestes* Ris, *Podopteryx* Selys, *Argiolestes* Selys, *Podolestes* Selys, *Megapodagrion* Selys, *Mesopodagrion* Selys, *Nesolestes* Selys, *Allopodagrion* Förster., *Philogenia* Selys, *Paraphlebia* Hagen, *Allolestes* Selys, *Dimeragrion* Calv., *Heteropodagrion* Selys *Protolestes* Först., *Heteragrion* Selys, *Mesagrion* Selys, *Burmargiolestes* Kenn., *Caledargiolestes* Kenn., *Celebargiolestes* Kenn., *Agriomorpha* May, *Lestomima* May.

Annectent forms:—I have already indicated *Thaumatoneura* as an annectent form to the Pseudostigmatidae. The genus *Rhipidolestes* is to some extent annectent to the Hypolestinae and Megalestinae (position of origins of 1R3 and R4 + 5), while *Rhinagrion* may perhaps be connected with the original stem of the Lestidae.

The genus *Taolestes* was originally placed by Needham in the family Lestidae, though both the form of its discoidal cell and the remarkable larval characters indicate that it does not belong there (xii). In removing it to the family Megapodagriidae, I also wish to indicate my opinion that this genus represents an archaic type which is to some extent annectent to the more ancient types within the superfamily Agrioidea, more particularly the Amphipterygidae. This problem will be further considered in Part II of this paper.

The Megapodagriinae are, with few exceptions, rare forms concerning which we know very little. Very few of the larval types are known. Until much more has been learnt about them, it will be impossible to disentangle the various lines of evolution within the subfamily.

Family 7. PLATYSTICTIDAE nov. fam. (Figs. 14, 23.).

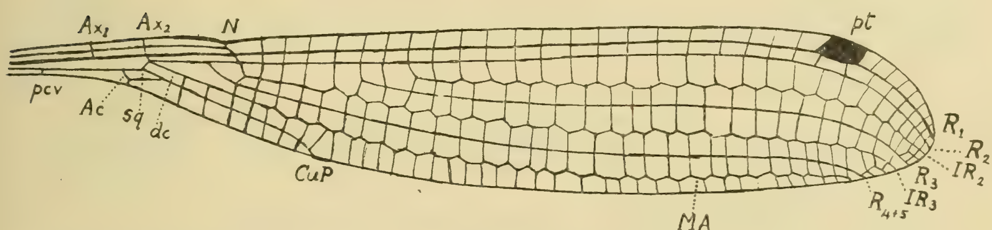


Fig. 23.

Subfamily *Platystictinae* Laidlaw, 1924, Spolia Zeylanica, 12: 360.

In the postcubital space (i.e., in the petiole between CuP and the posterior border of the wing) there is a cross-vein situated closer to the base of the wing than to the level of the proximal antenodal; a second postcubital cross-vein, the true *anal-crossing* (Ac) is also present, lying between the levels of the two antenodals and forming a part of the subdiscoidal cell, when that cell is present. Most of the cross-veins situated distal to the nodus are arranged in transverse series, the only breaks being due to zigzagging of veins 1R2, 1R3 and MA. Vein CuP is always reduced and vein 1A absent. No intercalated sectors present; origins of veins 1R3 and R4 + 5 always close to or at the subnodus; veins 1R2 and R3 both comparatively long, arising at least as far from the level of the pterostigma as from the subnodus, usually nearer to subnodus. Nodus at about one-fourth of the wing-length, or a little less. Pterostigma trapezoidal or rhomboidal, never elongate. Discoidal cell rectangular or subrectangular; subdiscoidal cell present or absent; if present, then reduced to a small cell of which the distal angle abuts on to the posterior side of discoidal cell.

(xii) It is unfortunate that Dr. Tillyard was unaware that *Taolestes* Needham is synonymous with *Rhipidolestes* Ris. The latter author correctly placed it near Podagrion, subfamily Megapodagriinae, so that the necessity to remove it to this subfamily does not arise. Moreover, by accepting the larva described by Needham as the larva of *Taolestes*, Tillyard has been led into a maze of errors. Actually this larva is one of Euphaea; probably that of *E. decorata* Selys.—Fraser.

Superior anal appendages forcipate or subforcipate.

Larva with flat, short, subquadrate labial mask, without any setae, the middle lobe cleft; gills triquetral.

The work of Laidlaw and Fraser has shown quite conclusively that this group is well differentiated from the Protoneuridae, with which they had previously been confused owing to the parallel reductions in the veins CuP and 1A. The most important difference, to my mind, is the presence of a very archaic character, viz., the additional, more basally situated post-cubital cross-vein, lying well before the level of the proximal antenodal. It can scarcely be doubted that this represents the cross-vein which originally supported the downturned distal end of the shortened CuA which is present in the Protozygoptera. A comparison of the position of this vein, and of the structure of the subdiscoidal cell, with the corresponding structures in the Protozygopterous family Kennedyidae, indicates clearly enough that we are dealing here with a primitive, reduced offshoot of the ancient Zygopteroid stock. The discovery of the larva by Fraser, with its Gomphid-like labial mask and triquetral gills serves only to confirm this view.

Two subfamilies may be recognized, as follows:—

Subfamily 1. PALAEMNEMATINAE nov. subfam. New World forms with 1R2 and R3 arising about midway between the subnodus and pterostigma; CuP not much reduced, ending beyond half-way along posterior border of wing.

Only one genus, *Palaemnema* Selys. (Neotropical.).

Subfamily 2. PLATYSTICTINAE Laidlaw. Old World forms with 1R2 and R3 arising nearer to the subnodus than to the pterostigma; CuP markedly reduced, ending at or before half-way along posterior border of wing.

Genera:—*Platysticta* Selys, *Protosticta* Selys, *Drepanosticta* Laid., *Ceylonosticta* Fraser. (All Oriental; no Australian genera.)

It may be noted that the number of postnodals is generally greater in the Platystictidae than in the next succeeding family, but this character has not been included in the definition owing to the fact that the number found in *Drepanosticta* (about fifteen) is equalled by that found in some Protoneuridae, e.g., *Phylloneura*.

In spite of the general resemblance between this family and the next, I doubt whether any true annectents can be indicated. I am inclined to consider that the two families have converged, through reduction of CuP and 1A, and through loss or reduction of the subdiscoidal cell, from two entirely different stocks. I doubt whether the Platystictidae have any close relatives amongst living Zygoptera. On the other hand, the Protoneuridae undoubtedly belong to the old stem of the Coenagriidae and Platycnemididae, and must be considered as a reduced offshoot from an early ancestor of those two families.

The three remaining families of Zygoptera are the Protoneuridae, Platycnemididae and Coenagriidae, in which the dominant impression given by the venation is the high degree of perfection attained by the transverse arrangement of the cross-veins distal to the nodus. Zigzagging of main veins is confined, at most, to the distal portions of 1R2, MA and 1A, so that there is little interruption to the completion of transverse series right across the wing. A few exceptions to this rule are to be noted, in

particular, the genus *Argia,* where the transverse arrangement is disturbed distally due to a slight broadening of the wing and consequent slight proliferation of cross-veins. The superior anal appendages of the males are always specialized, the original forcipate form not occurring. In the larvae, the mask is short and flat, with setae on the lateral lobes. These forms are dominant amongst the Zygoptera, more particularly the Coenagriidae, which can be described as damselflies *par excellence.*

Family 8. PROTONEURIDAE Tillyard. (Fig. 24.).

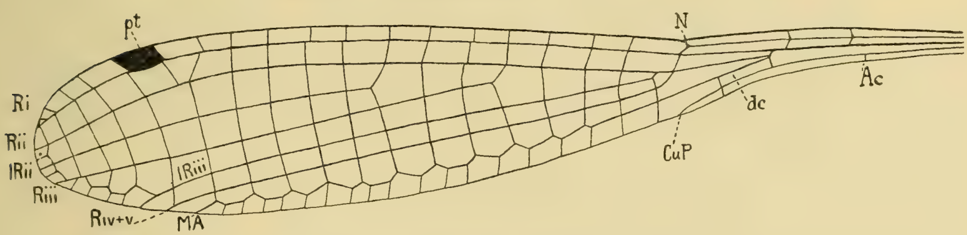


Fig. 24.—*Isosticta banksi* Till.

Protoneuridae Tillyard, 1926, Insects of Australia and New Zealand: 76.

No cubital cross-vein present before the level of the proximal antenodal. The sole postcubital nervure present is the anal-crossing (Ac) which lies between the levels of the two antenodals. Discoidal cell a narrow rectangle; subdiscoidal cell complete only in the most primitive genus, *Peristicta,* where its distal side is aligned with the distal side of the discoidal cell. In most forms the subdiscoidal cell is entirely absent and only the anal-crossing is left, but a series of reduction stages can be seen in such genera as *Idioneura, Prodasineura, Caconeura* and *Esme,* whereby it can be understood that the subdiscoidal cell in this family has undergone changes along entirely different lines from those in the Platystictidae, though both end up at complete suppression of the cell. CuP variable, often reduced; 1A greatly reduced or entirely absent; pterostigma always short, covering from about one-half to one and a half cells in length, variable in shape. 1R3 and R4 + 5 always arise close to subnodus, usually 1R3 at the subnodus and R4 + 5 slightly proximal, but in some genera one or both may arise just distal to the subnodus. 1R3 and R3 always arise well distal to subnodus and are separated by from two to four cells only. Generally all the main veins are straight except only MA, which is more or less zigzagged distally; more rarely 1R3 may be zigzagged for a short distance distally also. Correlated with the foregoing, the transverse arrangement of cross-veins is very complete. The nodus lies usually at about one-third of the wing-length from the base, sometimes a little more or less. Wings generally narrow, the petiole usually slender (rather broad in *Nososticta*).

Superior anal appendages of male very variable, sometimes forcipate (inferiors also sometimes forcipate), more often not. Very few larval types are known, but they appear to agree in the form of the labium, which generally has a cleft median lobe and lateral lobes of the Coenagrid type, with short movable hook, inner margin with teeth small and confined to its distal end, and setae present.

I am unable to subdivide this family into subfamilies. The Old World and New World forms appear to constitute two parallel series with closely similar characters, each still retaining genera with a complete subdiscoidal cell and running out to highly specialized forms with this cell obsolete and CuP greatly reduced.

Genera:—New World Series:—*Peristicta* Selys, *Neoneura* Selys, *Idioneura* Selys, *Microneura* Selys, *Protoneura* Selys, *Epipleoneura* Will., *Epipotoneura* Will., *Phasmoneura* Will., *Psaironeura* Will.

Old World Series:—*Chlorocnemis* Selys, *Disparoneura* Selys, *Caconeura* Kirby, *Esme* Fraser, *Phylloneura* Fraser, *Melanoneura* Fraser, *Elattoneura* Cowley, *Isomecocnemis* Cowley, *Nososticta* Selys, *Austrosticta* Till., *Neosticta* Till., *Notoneura* Till., *Orosticta* Till., *Selysioneura* Först, *Isosticta* Selys, *Prodasineura* Cowley. Of these, *Nososticta, Isosticta,* and all Tillyardian genera are Australian.

Family 9. PLATYCNEMIDIDAE nov. fam. (Fig. 25.).

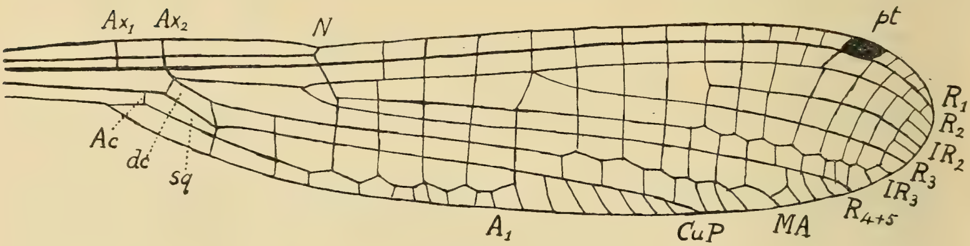


Fig. 25.

Subfamily *Platycneminae* Fraser, 1929, J. Bombay Nat. Hist. Soc., 33: 835.

Nodus situated at about one-third of the wing-length from the base, sometimes slightly more or less but never as close as one-fourth. Pterostigma small, more or less trapezoidal, usually more or less strongly braced. Transverse arrangement of cross-veins distal to subnodus very complete, the only main veins which are zigzagged being 1A, the distal part of MA, and, rarely, the distal part of 1R3. 1R3 and R4 + 5 arising close together at or near subnodus, 1R2 and R3 well distal to nodus and two to four cells apart. Discoidal cell never with the distal angle very acute; either short and rectangular (*Metacnemis, Mesocnemis*) or distinctly longer than wide, with the anterior side slightly shorter than the posterior. Subdiscoidal cell always present and complete (absent in *Tatocnemis*). CuP and 1A always well developed.

All species rest with the wings closed. Superior anal appendages of male very variable in form, not forcipate, though the inferiors are sometimes subforcipate. Larvae with labial mask of the Coenagriid shape and type, with median lobe entire, lateral lobes with teeth confined to the distal end, and setae present; caudal gills dilated broadly in their distal portions.

The genera included in this family all belong to the Old World and appear to form a single series beginning with *Metacnemis*, which appears to be annectent in some respects with the Megapodagriidae, and ending with the extremely petiolate *Tatocnemis*. There appears to be no necessity to subdivide the family into subfamilies for the present. Only a few larval forms are known so far.

Genera:—*Metacnemis* Selys, *Mesocnemis* Karsch, *Calicnemia* Strand, *Stenocnemis*, Karsch, *Platycnemis* Charp., *Copera* Kirby, *Coeliccia* Kirby, *Indocnemis* Laid., *Idiocnemis* Selys, *Paracnemis* Martin, *Leptocnemis*, Kirby, *Allocnemis* Selys, *Tatocnemis* Kirby, *Risiocnemis* Cowley. This family is unrepresented in Australia.

Family 10. Coenagriidae Tillyard. (Figs. 26, 27.).

Family *Coenagriidae* Tillyard, 1926, Insects of Australia and New Zealand, 76.

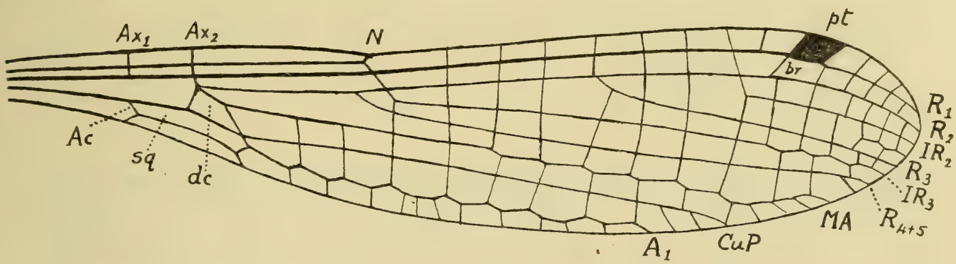


Fig. 26.

This family which is the most successful line of specialization within the whole suborder of Zygoptera, contains a very large number of genera and species, all of which present very much the same general appearance and type of venation. Nodus at about one-third the wing-length from base, never as little as one-fourth. Pterostigma always short, usually covering only one cell, more rarely two, sometimes less than one cell's length, variable in shape but mostly rhomboidal or trapezoidal. Transverse series of cross-veins distal to level of nodus almost always very complete, being only interrupted by the zigzagging of the distal portions of veins MA and 1A, with sometimes additional zigzagging of the distal portion of 1R3 also. Postnodals comparatively few in number, from five to twenty, but usually less than twelve. Veins 1R3 and R4 + 5 arising close together at or near subnodus; in most of the genera, 1R3 arising at the subnodus and R4 + 5 slightly proximal to it. 1R2 and R3 arising more distally, separated by from one to four cells. Discoidal cell with distal angle acute, the anterior side little more than half as long as the posterior. Veins CuP and 1A always well developed. Subcoidal cell always complete, usually entirely free from the posterior margin of wing but sometimes partly sessile on it; in shape it is elongate, from one and a half times to nearly twice as long as the discoidal cell.

Most of the species rest with the wings folded together over the thorax. Superior anal appendages of male never forcipate, usually very short, very variable in form. Larvae with short, flat labial mask, the median lobe entire, the lateral lobes with setae and with the teeth confined to the distal portion; caudal gills either nodate, subnodate or entire, the branch tracheae never at right angles to the main trunks.

While it is impossible to separate out the main evolutionary lines in this huge family satisfactorily, I think that there is still a good deal to be said for Selys original subdivisions, which I propose to recognize as the basis for subfamilies, as follows:—

Subfamily 1. Argiinae. Petiolation ceasing well before the level of

the anal-crossing (Ac); discoidal cell wider than usual for the family.

Genera:—*Hyponeura* Selys, *Argia* Rambur, *Onychoargia* Selys, *Palaiargia* Först., *Argiallagma* Selys, *Diargia* Calvert (xiii).

Subfamily 2. COENAGRIINAE. Petiolation ceasing a little before the level of the anal-crossing (Ac), so that the subdiscoidal cell still remains complete but the portion of the anal bridge proximal to *Ac* is much shorter than in the previous subfamily; discoidal cell not widened.

Series A. No spine at the end of the eighth sternite in the female (*Coenagrion* Series):—

Series B. A spine at the end of the eighth sternite in the female (*Ischnura* Series):—

Originally (Biology of Dragonflies, 1917, 280) I divided the subfamily Coenagriinae (portion of my Agrioninae of 1917) into three tribes, the Agrionini, Pseudagrionini and Teinobasini, which together with the Argiini, at that time considered to be only a tribe, made up the complete subfamily. The three tribes mentioned were separated out on the comparative slenderness of the forms, the amount of petiolation of the wings and the position of *Ac* in relation to the petiole.

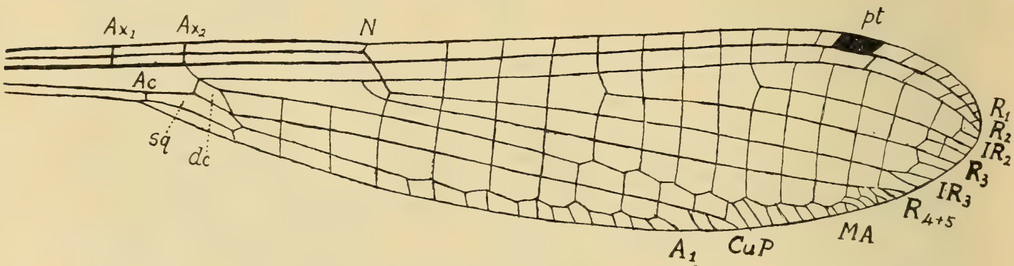


Fig. 27.

At the present time, with our additional knowledge of the evolutionary history of the Zygoptera, it can be seen that the problem of correctly classifying this enormous complex of forms is a purely secondary matter, which can be best undertaken as a separate study by somebody who can gain far more first-hand knowledge of the large mass of non-Australian genera than I can ever hope to do. I do not consider that my classification into tribes represents the true complexities of the evolutionary problem involved in the study of this dominant group. Therefore I shall be content, in this paper, to enumerate (a) the known Australian genera, and (b) the principal non-Australian genera. I might add that, in my opinion, the making of new genera in this group has gone, perhaps, too far, and that modern authors seem to think that genera were intended to indicate only *differences* between species, whereas it should be quite obvious that Linnaeus invented them to emphasize *relationships*.

(xiii) Kennedy has divided up the genus Argia into a number of others by employing penile characters: these are—*Chalcargia, Cyanargia, Heliargia, Leptargia* and *Micrargia*.—Fraser.

Australian genera:—*Ischnura* Charp., *Argiocnemis* Selys, *Agriocnemis* Selys, *Caliagrion* Till., *Austroagrion* Till., *Xanthagrion* Selys, *Pseudagrion* Selys, *Ceriagrion* Selys, *Aciagrion* Selys, *Archibasis* Kirby.

Old World genera (in addition to those given for Australia):—*Coenagrion* Kirby, *Pyrrhosoma* Charp., *Erythromma* Charp., *Nehallenia* Selys, *Thermagrion* Förster, *Mombagrion* Sjöst., *Argiagrion* Selys, *Xiphiagrion* Selys, *Teinobasis* Kirby, *Mortonagrion* Fraser, *Enallagma* Charp., *Himalagrion* Fraser.

New World genera:—*Amphiagrion* Selys, *Tigriagrion* Calv., *Hesperagrion* Calv., *Chromagrion* Need., *Anomalagrion* Selys, *Oxyagrion* Selys, *Acanthagrion* Selys, *Anisagrion* Selys, *Telagrion* Selys, *Leptagrion* Selys, *Megalagrion* McLach., *Hylaeagrion* Föerster, *Aeolagrion* Will., *Antiagrion* Ris, *Telebasis* Selys, *Metaleptobasis* Calv., *Ceratura* Selys, etc.

In addition, it should be noted that the genus *Ischnura* is practically cosmopolitan and that *Coenagrion* and *Enallagma* are widely spread throughout the Northern Hemisphere.

(To be continued.)

EXPLANATION OF TEXT-FIGURES.

1. *Dictyoptilus sepultus* Handl., Order Palaeodictyoptera. (Considered by Lameere to belong to the Odonatoid Orders, Group Stenodictyoidea.) Crossveins omitted for the sake of clarity. Convex veins shown thick to distinguish them from concave ones shown thin. *C*, costa, *Se*, subcosta, *Ri* radius, *Rs*, radial sector, *M*, anterior median, *MP*, posterior median, *CuA*, anterior cubitus, *CuP*, posterior cubitus, *1A*, first anal vein, *pca*, precostal area, *AxP*, axillary plate.
2. Odonatoid type of wing, base only shown. *AxP*, axillary plate.
3. *Protagrion audouini* Brong., Wing. Order Protodonata, family Protagriidae. (Upper Carboniferous of France.) Rii., Riii., and Riv + v principal branches of *Rs*. Other lettering as for Fig. 1.
4. *Typus permianus* Sell. Forewing. Order Odonata, suborder Meganisoptera, family Meganeuridae. Cross veins omitted for sake of clarity. Lettering as for Fig. 1.
5. *Megatypus schucherti* Till. Basal portion of hindwing with cross-veins included. *Ac*, anal crossing, *mb*, membrane. Other lettering as for for Fig. 1. Note the basal remnants of *Mp* and *CuA*. Same Order and suborder as *Typus permianus*, family Meganeuridae.
6. *Kennedya mirabilis* Till., Wing. Order Odonata, suborder Protozygoptera, family Kennedyidae. (Lower Permian of Kansas.) Note the basal remnant of *CuA* with its supporting cross-vein *pcv*. *Sq*, subquadrilateral or subdiscoidal cell, *pt*, pterostigma, *1Rii* and *1Riii*, intercalated nervures. Other lettering as for previous figures.
7. *Permagrion falklandicum* Till., Wing. Order Odonata, suborder Zygoptera, family Permagriidae. (Upper Permian of Falkland Islands.) *dc*, discoidal cell (an open one in this wing), *nv*, nodal vein, *snv*, subnodal vein. Other lettering as for previous figures.

8. *Permolestes gracilis* Martyn., Wing. Order Odonata, suborder Protozygoptera, family Permolestidae. (Permian of Russia.) Lettering as for previous figures. Note here also the basal remnant of *CuA* and its supporting vein *pcv*.
9. *Kennedya mirabilis* Till. Details of wing.—A. The petiole showing the faint basal portion of *Rs* + *MA* running below and parallel to *Ri*. Note the basal remnant of *CuA* supported below by the postcubital vein, *pcv*. *Avi*, proximal primary antenodal vein. B. Region of the arculus and discoidal cell. *Ac*, anal crossing, *arc*, arculus, *Ax2*, distal primary antenodal nervure, *dv*, discoidal cross-vein, *sq*, subdiscoidal cell. Other lettering as for previous figures.
10. *Protomyrmeleon handlirschi* Martyn. Forewing. Order Odonata, suborder Archizygoptera. (Jurassic of Turkestan.) Lettering as for previous figures.
11. The Costo-antenodal Complex. *C*, costa, *Sc*, subcosta, *R* + *M*, radial sector plus anterior media, *pan*, primary antenodal nervures, *san*, secondary antenodal nervures, *N*, nodus. The three figures demonstrate the gradual evolution from two solitary primitive antenodal nervures to the recent condition where these have been entirely replaced by the steady addition of weaker secondary antenodals.
12. *Hemiphlebia mirabilis* Selys. Forewing. Suborder Zygoptera, family Hemiphlebiidae. Lettering as for previous figures. Note the discoidal cell, *dc*, which is here an open one (but closed in the hindwing). Note also the vein *Ai* (1A) which is continued basalwards to run along the posterior border of wing. Lastly note that the postnodal nervures do not coincide with the cross-veins below them.
13. *Hemiphlebia mirabilis* Selys. 1-4 and 6. Base of wing enlarged to show the variable conditions of the anal-crossing and nervure *1A* met with. Note in Fig. 4 the presence of an apparent postcubital nervure similar to that found in the family Platystictidae. 5. Base of wing of *Agriocnemis pygmaea* (Ramb.) contrasted with the hindwing of *Hemiphlebia mirabilis* shown in 1 and 2.
14. *Platysticta deccanensis* Laidlaw. Basal portion of forewing, enlarged to show the postcubital vein, *pcv*, anal-crossing *Ac*, and subquadrangle, *sq*. Suborder Zygoptera, superfamily Coenagrioidea, family Platystictidae. (Recent, India.) (Adapted from Fraser.).
15. *Permagrion falklandicum* Till. Wing, probably a forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Permagriidae. Lettering as for previous figures. (Upper Permian, Falkland Islands.).
16. *Synlestes weyersi* Selys. Forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Synlestidae. (Recent Australia.) Lettering as for previous figures, except *o*, oblique vein.
17. *Chorismagrion risi* Morton. Basal portion of forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Synlestidae. (Recent, Australia.) Note the open discoidal cell, *dc*. In the hindwing, this cell is closed in the normal way.
18. *Austrolestes cingulatus* Burm. Forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Lestidae. (Recent, Australia.) Lettering as in previous figures, except *o*, oblique vein.
19. *Lestoidea conjuncta* Till. Forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Lestoideidae. (Recent, Australia.) Lettering as

in previous figures. Note the reduction of *CuP*, absence of *1A*, and the presence of an additional sector between *R2* and *1R2*.

20. *Pseudostigma aberrans* Selys. Hindwing (adapted from Munz). Suborder Zygoptera, superfamily Coenagrioidea, family Pseudostigmatidae. (Recent, Central America.) Lettering as for previous figures. Note the position of the nodus and the degradation of the pterostigma.
21. *Argiolestes icteromelas* Selys. Forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Megapodagriidae. (Recent, Australia.) Lettering as for previous figures.
22. *Thaumatoneura pellucida* Calvert. Basal portion of forewing (adapted from Munz). Suborder Zygoptera, superfamily Coenagrioidea, family Megapodagriidae. Lettering as in previous figures. Note the additional antenodals, not passing down on to *R1* (secondary antenodals). (Recent, Central America.).
23. *Platysticta deccanensis* Laidlaw. Complete forewing. Lettering as in previous figures. (See Fig. 14.).
24. *Isosticta banksi* Till. Hindwing. Suborder Zygoptera, superfamily Coenagrioidea, family Protoneuridae. (Recent, Australia.) Note the absence of the nervure *1A* and the reduction of *CuP*. Lettering as for previous figures.
25. *Platycnemis latipes* Selys. Forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Platycnemididae. (Recent, South Europe and Central Asia..) (Adapted from Fraser.).
26. *Coenagrion dyeri* Fraser. Hindwing. Suborder Zygoptera, superfamily Coenagrioidea, family Coenagriidae. (Recent, India.) (Adapted from Fraser.) Lettering as for previous figures
27. *Pseudagrion australasiae* Selys. Forewing. Suborder Zygoptera, superfamily Coenagrioidea, family Coenagriidae. (Recent, Australia.) Lettering as for previous figures

---

RAJA WHITLEYI, THE GREAT SKATE.

By Tom Iredale.

An excellent article on the Eggs of Australian Sharks and Rays, has just appeared in the Australian Museum Magazine (Vol. vi., No. 10). These have always attracted me since I first met with those of the Elephant Shark, containing embryos, on Sumner Beach, New Zealand, and found the late E. R. Waite greatly intrigued in the discovery. Since then, I have always picked up such articles where met with and was very interested in Mr. Whitley's article.

The name *Raja scabra* seemed familiar, and upon investigation was found to be inapplicable to the Great Skate of Australia. As here used. it referred to the introduction by Ogilby (Cat. Austr. Fishes, 1888, p. 17) for a preoccupied name given by Castlenau *Raya rostrata* in 1873. The name *Raja scabra* had been, however introduced by Linné (Mus. Adolph. Frid., Vol. ii., p. 52, 1764), so that our Skate is nameless. I am, therefore, with his permission, renaming the Ogilbyian species *Raja whitleyi,* and my colleague will deal intensively with it in his Handbook of the Sharks and Rays of Australia which he is now preparing. The type locality will be Port Phillip, Victoria. Mr. Whitley's oversight is the more remarkable as he and I pride ourselves that we carefully check all our references many times, yet even with our meticulousness errors may slip through.

FOUR NEW SPECIES OF AUSTRALIAN DRYOPIDAE.

By H. J. CARTER, B.A., F.E.S., and E. H. ZECK.

(Plate xiv.)

SIMSONIA BROOKSI *n.sp.*

(Plate xiv., figs. 3 and 9.)

Elongate ovate, nitid purple bronze above, subnitid chocolate brown beneath, glabrous; antennae red, apical segments infuscate, legs generally dark, tibia sometimes reddish.

Head closely and strongly punctate, eyes large and prominent

Prothorax bilobate, the lobes strongly convex and separated by a straight, wide and deep sulcus, extending the full width of the pronotum; widest behind middle, apex produced in middle, angles feebly advanced and subrectangular; base subtruncate, hind angles sharply rectangular, these emphasized by lateral sinuation; sides with well defined horizontal foliation, rather widely rounded on posterior lobe, with a shallow sinuation opposite the transverse sulcus, and a more abrupt posterior sinuation. Disk with rather large, close punctures, a short, inconspicuous lateral sulcus near hind angles.

Elytra considerably wider than prothorax at base, widest behind middle, a very narrow lateral horizontal border, becoming obsolete at apex; striate-punctate, seriate punctures round, large, close and regular, intervals flat and finely punctate, with some minute scattered setae. Sternal regions punctate, metasternum sulcate, abdomen impunctate, and glabrous. Prosternal process elongate, rounded at apex, carinate. Legs long.

Dim.: 2.1 x 0.8 mm.

Hab.: North Queensland, Cairns. (J. G. Brooks.).

We are indebted to Mr. Brooks for a long series of this distinct species, which we name after him. It is nearest *S. purpurea* Cart. in colour, but is readily separated by the deeper, straighter pronotal sulcus, wider lateral foliation and defined posterior sinuation; also the longer legs. Holotype presented to the Australian Museum.

AUSTROLIMNIUS METASTERNALIS *n.sp.*

(Plate xiv., figs. 2, 6 and 7.)

Widely ovate, subnitid black above and beneath, antennae, tarsi and underside of tibiae red.

Prothorax rounded and produced at apex, anterior angles defined; widest at base, sides thence lightly and arcuately narrowed to apex, lateral margins entire, hind angles rectangular, foliate margins separated from disk by sulcus, medial sulcus rather wide, of uniform width throughout, disk not discernibly punctate, of a silky surface.

Elytra as wide as prothorax at base, lateral ridges well raised, the innermost with a line of large punctures on the inside; seriate punctures well defined, small near base, increasing in size towards apex, intervals impunctate, latero-apical margins entire. Underside sublaevigate, metasternum with well raised medial carina, not quite extending to front margin, mesosternum with wide groove throughout bordering a carinate margin, angulate in middle. (In other species this border regular and entire.) Hind tibiae of ♂ enlarged and minutely spinulate on inside of apical half.

Dim.: 1.9 x 0.9 mm.

Hab.: Victoria. Bogong Plains, 6,000 feet altitude. (F. E. Wilson.).
Four examples taken in January, 1929, show a clear distinction from its congeners, though nearest to *diemenensis* in size. *A. victoriensis* C. & Z., the only other species having the tibiae of ♂ angulate, is smaller, more nitid, with very different meso and metasternal structure, the metasternum having carinate lateral borders. Holotype in Coll. Wilson.

NOTRIOLUS MINUTUS *n.sp.*

(Plate xiv., figs. 1 and 5.)

Short, widely ovate, nitid black, glabrous; antennae, tarsi and knees, a small shoulder spot, apical margins (narrowly) and the greater part of underside, red.

Head and *prothorax* finely, densely punctate.

Prothorax widest near base, apex emarginate, bisinuate, front angles prominent, base bisinuate, hind margins a little explanate, sides nearly straight for the greater part, arcuately narrowed behind, posterior angles obtuse. Disk flattened at middle, somewhat as in *N. subplanatus* C. & Z., the explanate margins more defined on front half.

Elytra widely ovate, wider than prothorax at base, a narrow, horizontal margin widened at apex, apices divergent and separately rounded; finely seriate punctate, striae subobsolete, intervals quite flat, with a glabrous, silky surface, the seriate punctures less evident than the rows of excrescences that appear to outline them. Prosternal process widely oval, its concave surface rather rugose; underside glabrous.

Dim.: 2.5 x 1.3 mm.
Hab.: North Queensland. Coen. (L. Wassell.).
Three examples kindly sent by Mr. Wassell are the smallest in the genus and clearly allied to *N. subplanatus* C. & Z., and *N. taylori* C. & Z., in structure, which three form a distinct group by their wide form and prosternal process. Holotype in the Australian Museum.

NOTRIOLUS TROPICUS *n.sp.*

(Plate xiv., figs. 4 and 8.)

Ovate, black, moderately nitid and convex. Underside black; tarsi reddish, antennae red with two basal and the apical segments black.
Head finely punctate, eyes little prominent.

Prothorax widest at basal third, thence obliquely narrowed to apex, more gradually narrowed to base; base bisinuate, marked by narrow transverse depression near base; lateral border narrowly horizontal, forming a subacute angle in front, subrectangular behind; disk evenly, densely, punctate.

Elytra considerably wider than prothorax at shoulders, widest behind middle, with narrow horizontal border, apices separately rounded; striate-punctate, the striae well marked near suture, elsewhere rather indistinct, strial punctures round and close, the two sutural intervals lightly raised, the others flat; all finely punctate. Prosternum strongly and closely, metasternum more coarsely and distantly, punctured; prosternal process bluntly rounded at apex, its margins raised.

Dim.: 3.8 x 1.7 mm.

Hab.: N. Queensland. Ravenshoe & Millaa-Millaa. (Mr. J. G. Brooks.).

About 30 examples sent show a species closely allied to *N. allynensis* Cart., but clearly distinct as follows:—Size larger, prothorax widest at basal

third (at, or near, base in *allynensis*); elytral intervals not wrinkled, underside darker and considerably more coarsely punctate. Holotype in Coll. Carter.

N.B.—Under a lens *N. allynensis* can be readily distinguished from the other all-black species by its transversely wrinkled elytra.

N. subplanatus var. Some examples from Ravenshoe, sent by Mr. Brooks, have a small, pale shoulder spot, not found in typical specimens.

EXPLANATION OF PLATE XIV.

Fig. 1. *Notriolus minutus.*
„ 2. *Austrolimnius metasternalis.*
„ 3. *Simsonia brooksi.*
„ 4. *Notriolus tropicus.*
„ 5. Sternal process of *Notriolus minutus.* x 42.
„ 6. Sternal process of *Austrolimnius metasternalis.* x 42.
„ 7. Mid-tibia and tarsus of male *Austrolimnius metasternalis.* x 96.
„ 8. Sternal process of *Notriolus tropicus.* x 42.
„ 9. Sternal process of *Simsonia brooksi.* x 42.

A NEW NAME FOR AN OLD SHELL.

By Tom Iredale.

Mr. Melbourne Ward has returned from a six months' cruise on H.M.A.S. Moresby, on which he was acting as naturalist. He has brought back from the Northern Territory an exceedingly interesting collection of molluscs, and one of the most notable was the curious Fusoid whelk known as *Galeodes* or *Melongena cochlidium* Linné or Lamarck. Reference showed that *Murex cochlidium* Linné (Syst. Nat., Ed. x., p. 753, January 1, 1758) was based solely on Argenv. conch., t. 12, Fig. A, without locality. The figure represents a shell quite unlike the one under notice, and this accounts for the citation to Lamarck, who had used Linné's name for our shell. Apparently no one has rectified this error, though the shell has been well figured by Reeve (Conch. Icon., Vol. iv., Pyrula, pl. i., fig. 2, May, 1847; Raine's Island, Torres Straits), and the animal by Hombron and Jacquinot (Voy. Pôle Sud., Atlas, Moll., pl. 22, fig. 37, 1851; Raffles Bay). I (Proc. Mal. Soc. (Lond.), Vol. xii., p. 323, 1917) showed that *Galeodes* was invalid, and that *Volema* Bolton, 1798, should supersede *Melongena* Schumacher, 1817, but the present species differs generically. I therefore propose the new generic name *Volegalea*, the shell being stoutly fusiform, the canal short and broad, the spire about equal to the aperture and the columella smooth, the outer lip sharp, the thick operculum leaf-shaped. I select for the specific name *wardiana*, citing Reeve's description and figure, and will discuss the variation later.

DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN CERAMBYCIDAE (COLEOPTERA).

By Keith C. McKeown,
Assistant Entomologist, Australian Museum, Sydney.

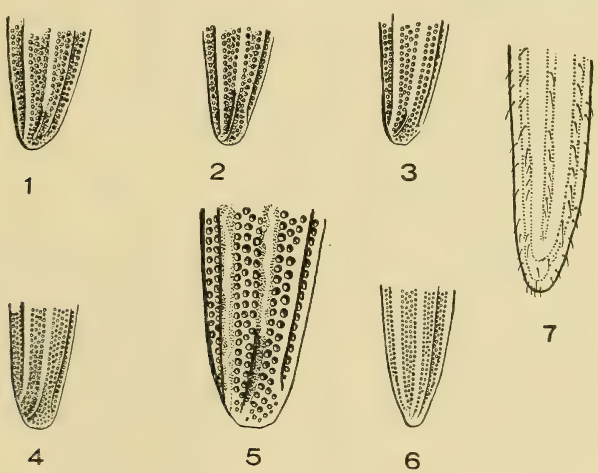
(Contribution from the Australian Museum, Sydney.)

(Plate xv. and text-figure.)

Shortly after the publication of my revision of the Australian species of the genus *Syllitus* (Rec. Aus. Mus., xx., 2, 27 August, 1937, pp. 108-116, pls. xviii-xix), I received a small collection of insects belonging to this genus from Mr. A. R. Brimblecombe, Assistant Research Officer, Department of Agriculture and Stock, Brisbane, Queensland, with the request that I should identify them. On examination I found that the collection was of exceptional interest, since the majority of the species included were apparently new to science.

Mr. Brimblecombe very kindly agreed to my suggestion that I should be permitted to describe any new species, and their descriptions together with those of several additional species from the Australian Museum Collection, and two new species of the allied genus *Aphiorhynchus*, comprise the present paper. In all ten new species are described, and one new genus defined, forming a very interesting addition to the Cerambycid fauna of Australia, and particularly in these hitherto but little collected genera, in which, no doubt, many undescribed forms still await discovery.

My sincere thanks are extended to Mr. Brimblecombe for his kindness in submitting the material to me and permitting its description, and to Miss N. B. Adams for the preparation of the plate and text-figures.



EXPLANATION OF TEXT FIGURES.

Apices of elytra: Fig. 1, *Syllitus tuberculatus* sp. nov. Fig. 2, *Syllitus araucariae* sp. nov. Fig. 3, *Syllitus dubius* sp. nov. Fig. 4, *Syllitus cassiniae* sp. nov. Fig. 5, *Syllitus sinuaticosta* sp. nov. Fig. 6, *Syllitus brimblecombei* sp. nov. Fig. 7, *Syllitosimilis aberrans* sp. nov.

(N. B. Adams del.).

Genus SYLLITUS Pascoe, 1858.

SYLLITUS ARAUCARIAE *sp. nov.*

(Plate xv., fig. 4 and text fig. 2.)

♀. Slender. Head and thorax pale ochraceus, lightly rugose, semi-nitid. *Head* considerably broader than prothorax, eyes large, prominent. *Thorax* strongly constricted throughout apical third, laterally tumid at about two-thirds, constricted at base, but not so narrowly as at anterior third. *Antennae* not reaching to extremity of body, dark brown; antennary tubercles not prominent. *Elytra* dark nigro-fuscus, coarsely and regularly punctate, with lateral margin and two narrow raised costae on each elytron creamy-white, the margins of the lines irregularly indented by punctures of the inter-costal area. First pale costa longer than second, extending almost to apex; a short, strongly defined, concolorous costa extending from shoulder to about 1/7th length of elytron or less. *Lateral margin* very slightly emarginate, marked with a clear white line and terminating just before apex. First costa parallel to suture, second approximately parallel to first, converging towards apex. Area between first and second costae much more closely, finely, and irregularly punctate than that between second costa and lateral margin, where the punctures tend to be shallow, circular, and ranged in definite rows. *Legs* pale stramineous, femora and tibiae very finely punctate, with a sparse clothing of scattered whitish hairs. *Ventral surface*: Sternum dark ferruginous, abdomen black, semi-nitid, lightly punctate.

Long.: 6½ mm.

♂. Similar to female, but smaller. Antennae reaching to extremity of body. Head with a small yellow patch before each eye.

Long: 5 mm.

Hab.: Imbil, Queensland. (A. R. Brimblecombe). August, 1936.

Host Plant: Bred from *Araucaria cunninghami.*

Holotype ♀ and allotype ♂ in Queensland Museum, Brisbane.

A series of seven specimens comprising 5 ♀♀ and 2 ♂♂; the females measuring 6 mm., 6½ mm., and 5 mm.; the males 5 mm.

SYLLITUS BRIMBLECOMBEI *sp. nov.*

(Plate xv., fig. 10 and text fig. 6.)

Moderately slender. Head and thorax dark stramineous, glabrous, nitid. *Head* medium, eyes prominent, antennary tubercles prominent. *Antennae* dark brown, clothed with a very fine ashy pubescence. *Thorax*: Anterior half cylindrical, basal half laterally roundly tuberculate, dorsally with two high rounded tubercles on disc. *Elytra* stramineous-brown, becoming darker towards apex; each elytron with lateral margin and two strong raised costae, white; a narrow, slightly elevated costa rising near shoulder and terminating at apex, slightly white on basal half, concolorous on apical half. First pale costa (subsutural) shorter than second, not reaching apex, straight and parallel to suture; second reaching apex, generally parallel to first, but diverging very slightly towards centre, and converging again sharply near apex, where it terminates on sutural line. Lateral costa somewhat strongly emarginate. Interspaces between costae rather coarsely and irregularly punctate. *Legs* light stramineous.

Long.: 8 mm.

Hab.: Brisbane Queensland, November 13, 1921.

Holotype in Queensland Museum, Brisbane.

Other specimens in the series measured 7-8 mm. in length. I believe that all the specimens examined are females.

Named in honour of Mr. A. R. Brimblecombe, Department of Agriculture and Stock, Queensland.

SYLLITUS CASSINIAE *sp. nov.*

(Plate xv., fig. 5 and text fig. 4.).

Very slender. Black. Head and thorax strongly rugose. *Head* small and narrow, not wider than prothorax. *Thorax* cylindrical, very slightly tuberculate laterally on posterior third. *Elytra* black suffused with a brownish tint, finely and regularly punctate; lateral margin and two raised costae on each elytron narrowly white; first (subsutural) pale costa parallel to suture, second parallel to first; a well defined concolorous raised costa extending from the shoulder to apex between second costa and lateral margin. Lateral margin narrowly white; first pale costa shorter than second; first and second costae not converging towards apex; concolorous costa converging strongly toward second near apex, then diverging sharply to lateral margin. *Antennae* black, smooth, nitid at apex of joints, becoming suffused with reddish-brown over apical third, basal joint with thin white pubescence. *Legs* black, punctate, semi-nitid.

Long.: 6 mm.

Hab.: Gore, Queensland (A. R. Brimblecombe), August, 1935.

Host Plant: Bred from Rosemary (*Cassinia laevis*).

Holotype in Queensland Museum.

An interesting species with a general resemblance to *S. uniformis* Blkb., but differing in the presence of white costae and other features.

SYLLITUS CENTOCRUS *sp. nov.*

(Plate xv., fig. 9.).

Robust. *Head* dark ferruginous, finely punctate. *Thorax* ferruginous, rugose, with slight rounded lateral expansions (scarcely tubercles) about basal third; two small dorsal tuberculate elevations on same area. *Elytra* bright ferruginous, almost stramineus, punctate; each elytron with lateral margin and two raised costae yellow; lateral margin only lightly and narrowly yellow, costae strong. First costa sharply divergent to suture towards centre; second costa equally divergent to lateral margin forming a wide lenticular space between the costae; the widest portion of this area is more finely punctate and definitely darker than the remainder of the elytra. A fine double costa, concolorous with elytra, runs from shoulder to apex between second costa and lateral margin. Apices narrowly tipped with black. *Antennae* dark brown, base of first joint red, basal area of succeeding joints more or less suffused with red. *Legs*: Femora black, tibiae and tarsi bright ferruginous; hind tibiae, with the exception of basal area at joint, suffused with brownish-black.

Long.: 9 mm.

Hab.: Queensland. (A. H. Elston Collection.).

Holotype in Australian Museum, Sydney.

A comparatively large pale coloured species which does not bear any resemblance to any of its congenors. It is unfortunate that the label does not bear a more definite locality.

Syllitus dubius *sp. nov.*

(Plate xv., fig. 3 and text fig. 3.).

Slender. Head and prothorax bright orange-ferruginous, very lightly rugose, semi-nitid. *Head* relatively large and broad. *Thorax* cylindrical over anterior two-thirds, widening to a laterally tuberculate expansion on basal third where disc is depressed dorsally, the depression being roughly lunulate with the apices of the crescent directed forwards. *Antennae* black, somewhat nitid, not reaching to extremity of body. *Elytra* black, coarsely and regularly punctate, with lateral margin and two broad, smooth, sub-nitid raised costae of a pale stramineous colour on each elytron. First, or subsutural, pale costa parallel with suture; second diverging gradually from behind shoulder, and converging near apex; first costa longer than second, and reaching to apex of elytron. *Legs*: Femora stramineous, tibiae clouded with black tarsi tending to black. *Ventral surface*: Sternum, prosternum, and abdomen black, semi-nitid, minutely punctate, somewhat sparsely clothed with fine, short grey hairs.

Long.: $6\frac{3}{4}$ mm.

Hab.: Brisbane, Queensland, October 22, 1929.

Holotype in Queensland Museum, Brisbane.

Other specimens in the series measure 6-$6\frac{1}{2}$ mm. in length.

This species is close in general appearance to *S. microps* Blkb., but may be readily separated from that species by the fact that the first, or subsutural, pale costa is longer than the second.

Syllitus sinuaticosta *sp. nov.*

(Plate xv., fig. 6 and text fig. 5.).

Slender. Head and thorax bright ferruginous. *Head* broad, wider than thorax; two raised carinae from antennary tubercles. *Thorax* narrow, anterior half cylindrical, laterally slightly tuberculate at basal three-quarters of thoracic length, slightly rugose, semi-nitid. *Antennae* black, dull. *Elytra* black; each elytron with lateral margin and two nearly parallel, very narrow, strongly sinuate, white costae. First white costa almost reaching apex, longer than second. Interspaces between costa finely and regularly punctate. *Legs* bright yellow, third pair suffused to a slight degree with brown.

Long.: 6 mm.

Hab.: Queensland.

Host Plant: *Cassinia* sp.

This small species is possibly the most remarkable member of the genus known to me; the costae are wholly unlike those of any other species of the group, in which they are sharply defined, or, at least, only slightly indented on the margins by the intrusion of elytral punctures. In the present species the strongly sinuate appearance of the extremely fine (almost linear) costae is not produced by the punctuation of the elytra. The sinuate effect is especially strong over the apical portion of the elytra, giving the insect, when examined under a high power of the microscope, a remarkable and beautiful appearance.

Syllitus tuberculatus *sp. nov.*

(Plate xv., fig. 8 and text fig. 1.).

♀. Slender. *Head* dark ferruginous, dark brown to black over area be-

hind eyes and between junction between head and prothorax. A prominent rounded granulose tubercle placed laterally behind eye. Antennary tubercles well developed, prominent. *Thorax* dark brown, apical and basal third finely corrugated. *Elytra* black, with lateral margin of each elytron and two raised costae white. First or subsutural, costa narrowly white, generally parallel to suture, but approaching it slightly near centre; second pale costa considerably shorter than first; a narrow concolorous line extending from shoulder to apex between second costa and lateral margin, becoming more marked over apical half. Lateral margin very narrowly edged with white. Interspaces between costae finely and irregularly punctate. *Antennae* black, nitid, four apical joints with a fine greyish bloom. *Legs* ferruginous, tibiae and tarsi diluted with black.

Long.: 7 mm.

♂. Similar to female but smaller; antennae reaching to extremity of body.

Long.: 5 mm.

Hab.: Queensland, Bunya Mountain, 3 000 feet. (N. Geary). December, 1937, to January, 1938; Benarkin (H. Hacker), April 17, 1933.

Holotype ♀ and allotype ♂ in Australian Museum, Sydney.

An exceedingly interesting little species remarkable for the prominent granulose tubercle on the side of the head, a feature which renders its identification simple, since it can be detected with the aid of a medium powered lens alone. The manner in which the concolorous costa from the shoulder becomes more sharply defined as it approaches the apex, is also distinctive. Other examples in the series measure 5, 6, and 7 mm. in length.

In addition to the specimens from the Department of Agriculture and Stock, Queensland, I have a remarkably fine series of over sixty specimens before me taken by Mr. N. Geary on Bunya Mt. It is seldom that such numbers of specimens of a new species are available for examination.

Genus Aphiorhynchus Lacord, 1869.

Aphiorhynchus costatus *sp. nov.*

(Plate xv., fig. 1.).

Slender, elongate. Ferruginous, elytra black with lateral margin and two raised costae white. *Head* with a rather slender elongate muzzle, pale ferruginous clouded with black on posterior lobes and narrowly along sides; extremity of body, black, nitid, first joint very elongate-clavate, longer than joints 2-4 combined, joints 3, 4, and 6 approximately equal, 5 slightly longer than 3, 4, and 6. *Thorax,* ferruginous clouded with brown, narrowly fusiform slender, much longer than broad, strongly constricted anteriorly but gradually widening to base, slightly tumid laterally about posterior third, anterior border straight, strongly emarginate, posterior margin weakly sinuate. *Elytra* black with lateral margin and two narrow, almost parallel raised costae white; subsutural costa parallel with suture reaching apex, second approximately parallel to first not reaching apex, the lateral margin incurved abruptly and approaching first costa near apex; elytra wider at shoulders than base of prothorax, slightly constricted about anterior third, then widening somewhat before tapering to the apices about posterior fourth; interspaces between costae coarsely and regularly punctate. *Legs* long, slender, pale ferruginous.

Long.: 10½ mm.

Hab.: Queensland, Bunya Mountain, 2,000 feet (N. Geary), December, 1937.

Holotype in Australian Museum, Sydney.

This fine insect is quite unlike any species of *Aphiorhynchus* known to me. The puncturation of the elytra together with the slender raised white costae are very similar to those of members of the genus *Syllitus* to which, apart from its very slender form, shape of head, etc., the insect bears a strong superficial resemblance.

Other examples in the series before me measure 10½, 10, and 9 mm. in length.

APHIORHYNCHUS VERSICOLOR *sp. nov.*

(Plate xv., fig. 7.).

Slender. Ferruginous varied with brown and metallic blue black. *Head* produced into a broad muzzle, bright ferruginous clouded with fuscus towards base, a strong linear carina joining antennary tubercle and point of insertion of palpus on each side black; eyes large, prominent, coarsely granulate, black; palpi black; antennary tubercles small, not prominent. *Antennae* longer than body, black, nitid, apical joints slightly pruinose; first joint very elongate-clavate longer than joints 2-4 combined, 5 longer than 4, 4, and 6 about equal length. *Thorax* dark ferruginous, much longer than broad, somewhat fusiform, strongly constricted anteriorly widening gradually to posterior two-thirds where it is laterally tuberculate, then narrowing slightly to base, much wider at base than anteriorly, anterior margin straight not emarginate, posterior margin slightly procurved. Elytra narrow, wider than prothorax at shoulders, tapering gradually and regularly to apices, finely punctate anteriorly, more coarsely posteriorly, apices squarely truncate; each elytron with three concolorous raised costae anteriorly, four posteriorly, subsutural costa not reaching apex, second coalescing with third before apex, third rising below shoulder and reaching apex, fourth arising from about posterior third and terminating before apex; the ground colour of the elytra is yellow, with a somewhat irregular basal area, rounded posteriorly and not reaching sides, heavily clouded with rich brown extending from near base to about half-way, a broad transverse fascia of the yellow ground colour about half-way coalescing with light margins, an irregular apical patch, rounded somewhat anteriorly, of rich metallic blue-black. *Legs* very long, slender, pale ferruginous; femora black at base; tarsi clouded with black; hind tibiae clouded with brown.

Long.: 10 mm.

Hab.: Queensland, Bunya Mountain, 2-3,000 ft. (N. Geary), December, 1937.

Holotype in Australian Museum, Sydney.

This striking particoloured species comes closest to *A. divisus* Pasc., by reason of the dark apical area of the elytra, but the coloration together with other characters will serve to distinguish them. The apical dark patch in *divisus* is almost straight anteriorly. Other specimens in the series measure 9 and 10 mm.

Genus SYLLITOSIMILIS *nov.*

Head broad, rounded, and dorsally depressed; eyes large, reniform, coarsely granulate; antennary tubercles prominent. *Antennae* slender,

basal joint elongate-clavate. *Thorax* cylindrical anteriorly, laterally tuberculate-emarginate basally. *Elytra* narrow, parallel, marked with setulose costae of a lighter colour. *Legs* with clavate femora.

SYLLITOSIMILIS ABERRANS *sp. nov.*

(Plate xv., fig. 2 and text fig. 7.).

♀. Relatively stout; bright ferruginous. *Head* and *thorax* dark ferruginous. *Head* broad, rounded, finely granulate, depressed along clypeal suture; a deep longitudinal median groove extending from clypeal suture and terminating abruptly just before junction of head with anterior margin of prothorax; eyes large, reniform, coarsely granulate; antennary tubercles large and prominent. *Antennae* slender, bright ferruginous, finely and irregularly punctate, with short black hairs seated in punctures; reaching to extremity of body. First joint elongate-clavate, second and third of equal length, 4-8 longer than 2-3, and of equal length, 9-11 shorter, approximately equal; joints 2-11 narrowly cylindrical. *Thorax* ferruginous, considerably narrower than head, longer than broad, cylindrical, broadly tuberculate-emarginate laterally on basal half, finely rugose. *Scutellum* as broad as long, rounded behind. *Elytra* narrow, parallel-sided, tapering somewhat sharply to apices which are slightly divergent; finely and transversely rugose, ferruginous, with three very slightly raised elytral costae of a bright, rich stramineous; each costa with stout, semi-erect, backwardly-directed, pale stramineous setae placed at moderately regular intervals along its length. First, or subsutural, costa parallel to suture, second and third costae converging and coalescing at apex. Lateral margin slightly emarginate on basal fourth. *Legs* clear, pale ferruginous, femora somewhat elongate-clavate, tibiae with scattered dark hairs chiefly concentrated around apical joint.

Long.: 7 mm.

♂. Similar to female, smaller. Antennae longer than body.

Long.: 5 mm.

Hab.: Queensland, Enoggera (type); New South Wales, Richmond River, and National Park (allotype).

Holotype ♀ in Queensland Museum, Brisbane. Allotype ♂ in Australian Museum, Sydney.

This very interesting species was submitted from the Queensland Department of Agriculture and Stock as a *Syllitus*; other specimens in a less satisfactory state of preservation were unnamed in the Australian Museum Collection from the Richmond River and National Park, New South Wales. The insect bears a remarkably strong resemblance to a *Syllitus*, but on examination, although many of the characters agree with those of that genus, the large reniform eyes at once exclude it from that group. The setulose costae are another striking feature. On these and other characters, a new genus appears to be required for its reception. Its correct position is uncertain.

EXPLANATION OF PLATE XV.

Fig. 1. *Aphiorhynchus costatus* sp. n.
,, 2. *Syllitosimilis aberrans* sp. n.
,, 3. *Syllitus dubius* sp. n.
,, 4. *Syllitus araucariae* sp. n.
,, 5. *Syllitus cassiniae* sp. n.
Fig. 6. *Syllitus sinuaticosta* sp. n.
,, 7. *Aphiorhynchus versicolor* sp.n.
,, 8. *Syllitus tuberculatus* sp. n.
,, 9. *Syllitus centocrus* sp. n.
,, 10. *Syllitus brimblecombei* sp. n.

(N. B. Adams, del.).

THE HUNTSMAN-SPIDER (*ISOPEDA IMMANIS*).

COURTSHIP, MATING, SAC-CONSTRUCTION, EGG-LAYING AND EMERGENCE OF SPIDERLINGS.

By Edith Coleman.

(Plates xvi.-xviii.)

The large, hairy-legged Huntsman-spider, *Isopeda immanis,* is so common under the bark of Acacias and Eucalypts, in sheds and even in our houses, that one is surprised to find how little is known regarding its habits. After only a short acquaintance, it will be pronounced one of the easiest spiders to study, as well as one of the most fascinating. It is commonly, but erroneously, called a Tarantula. Attempts have been made to establish the names Huntsman-spider, Crabspider, and the inapt "Tri-antelope". The former, which is descriptive, has been adopted in these notes. During the past three years I have confined a number of Huntsman-spiders of all ages, and of both sexes, in glass cages. In many instances male and female adults have lived together for months. Notes on six mated pairs have been made while ecdysis, courtship, mating, sac-construction and emergence of young were observed.

The following notes, dealing with one pair, may be taken as typical of them all. Courtship display and attachment of the egg-sac have differed slightly in unimportant details.

A large female of an unnamed species was caged (Dec., 1936). If disturbed, she reared, exposing her "danger signal"—a large, velvety-black splash on the ventral surface of her golden-brown abdomen. When captured, a smaller, probably male, spider, was with her, but not being so handsome, it was not taken. For several weeks she seemed contented, eating well and daily growing more corpulent. Unfortunately I mis-read her appearance of well-being. For company I gave her an adult male Huntsman-spider. Next morning I found him with his falces buried in her body, between cephalo-thorax and abdomen—the usual spider-grip in mortal combat. She was quite dead. I removed the body which was sent to the National Museum for identification. Whether the male spider would have devoured it I do not know, but I think not. I have known other males to kill a female, but in not one instance has any attempt been made to eat it.

On February 11th, 1937, I quietly placed in the cage of the male Huntsman-spider a large, but immature, female of his own species. They lived together on the best of terms, but did not mate until March 27th, after the final moult of the female. In such a confined space (8 in. x 10 in. x 6 in.) it would have been easy for either to attack the other. Instead, they spent many hours, day and night, in beautiful courtship displays, at other times resting on the same wall of the cage with legs overlapping. Like all my captives, when not courting, they rested during the daytime on the brown cardboard roof, coming down only to capture flies. These and meal-worms were freely taken. Woodmoths, Mantids and Long-horned Grasshoppers were greatly relished.

During their many graceful courtship parades, shy advances and retreats appeared to be part of the ceremony. Running to meet each other, they would gently touch feet, and then retreat hastily as if alarmed. Walking on tiptoes, body high off the floor, the male would advance, shaking

his palpi, as one shakes drops of water from one's fingers, while violent tremors shook his body.

Both would extend anterior legs to their full extent, crossing swords, or feinting between interplay of legs. Occasionally the female would make a playful lunge, and the male would retreat in what I assumed to be mock alarm.

I think the male is always quite conscious of the female's attitude towards him, friendly or hostile. Often the male spent 10 minutes or more in preening his palpi, drawing the whole palpus through his chelicerae, or holding it there for perhaps five minutes. Sometimes he withdrew the embolus, still coiled, looped on a falx, like a quoit on a peg. He might then shake it violently, or draw the whole length, taut, between his chelicerae, as a bird passes the length of a feather through its bill. This preening was indulged in by all the males, after their final ecdysis, even when alone in a cage.

The palpal organ is complicated. The preening probably ensures correct re-arrangement after displacement. Normally, the extremely long embolus is coiled in two spirals, within one of which lies a light brown coiled-cup. I have been unable to satisfy myself as to the function of this cup. I assume that it may be brought into use during sperm-induction, or it may protect and support the embolus when copulation is not in progress. It possibly acts as a reservoir, or perhaps the receptaculum seminis is coiled within it. The coils of the cup are connate. If an opening exists at its extremity it is minute. When the male is eager to copulate, the cup and part of its style protrude beyond the palpus. The female Huntsman-spider, although not fully mature, exhibited the same eagerness during courtship displays.

Often she led matters, dropping from the roof to walk round on tiptoes, abdomen vertical or nearly so. A chase would ensue, the male being alternately the pursuer and the pursued. It was delightful to see each teasing the other with extended sense-tipped legs, retreating if the invitation were accepted.

During these displays the palpi of the male were close together, curved downward and inward. They drummed on the floor as he walked. At other times they were outspread, like semaphores; as he advanced with anterior legs stretched high in the air. When not displaying, the male sometimes rested on the female, an attitude which may have been protective, for, in this position, the female could not attack him; but I do not think he had occasion to fear her: When once the spiders are on courtship terms the male always appears to be safe, until after impregnation of the female.

If anxious to play, both would walk round and round roof, walls and floor of the cage, in measured pace, graceful as a minuet, side-stepping, arching and pointing a leg, as a dancer arches an instep to point a toe. The whole display is indescribably beautiful. If filmed it should awaken interest in, and admiration of, these graceful spiders. For more than six weeks it was obvious that the male wished to copulate, but was not pressing his attentions beyond a certain stage. It seemed as if he were waiting for the female's final moult.

It is generally believed that spiders are not sexually mature until final ecdysis. I am able to offer evidence that points to a contrary view in what are probably exceptional instances.

In the present case, as will be seen from the illustration, the epigynal aperture was not yet exposed. (Plate xvi., fig. 2.)

On March 27th, at 8.30 a.m., the female had moulted. At 2.15 p.m. copulation was in progress, the right palpus of the male being applied, without interruption, to her epigyne. There was little or no movement of the palpus, which was bent at the meta-tarsus, at an angle of about 45 degrees. The tibial spur, caught under the epigynal margin, appeared to be holding it in position. The haematodocha was greatly dilated, bean-shaped at its fullest distension, greenish-blue, like a flame. It was visible to the naked eye at a distance of 4 feet. In 40 minutes it was inflated, and deflated, five times. During inflation of the haematodocha the coiled cup and its style were thrown half round the base of the palpus, returning upon deflation. It appeared to be heaved, or pumped, round. The basal coil of the glossy, dark-brown embolus, revolving like a wheel, seemed to thicken during the rhythmical inflations. These, repeated every three minutes or so, remained distended, and motionless, for about 5 minutes.

A considerable portion of the embolus appeared to be within the vulva during the whole time that the right palpus was applied, a period of 3 hours 25 minutes. The female was perfectly immobile. I could not detect the slightest movement of her body. The male then moved above the female, the embolus stretching to its full extent before springing back into the palpus. The left palpus was then preened.

I watched closely for sperm-induction. It did not take place, nor did I see it take place between copulations on any occasion. I examined the cage under a lens for sign of sperm-sheet. Later I used cages with collapsible walls to provide better facility for examining both sides of the glass, but could find no trace of sperm-web. It is, of course, possible that I overlooked it, but I do not think so, for I watched several males very closely after a palpus was withdrawn.

I assume that sperm-induction in this species takes place only once, after final ecdysis, and that a single charging of the palpi is sufficient for prolonged copulation. Copulation was resumed at 6.40 p.m. The left palpus being applied continuously until 11 p.m.; distension of the haematodocha taking place at five-minute intervals as before, and as I have seen it many times since.

The spiders were apart, motionless, on opposite walls at night. The cage stood on a table beside my bed. I frequently switched on the light and made notes.

Further periods of copulation were as follows:—

March 28th.—R.P., 9.45 a.m.-5 p.m. I saw the application and separation. L.P., 5.5 p.m.-8.35 p.m.: Apart all night.

March 30th.—No copulation. The spiders rested together, legs overlapping.

March 31st.—R.P., 1 p.m.-6.45 p.m. I again saw separation.

April 1st.—No copulation. Spiders together, face to face, legs overlapping. The female at no time hostile.

April 2nd.—R.P., 1.30 p.m.-5.20 p.m. Distensions of haematodocha as usual. I frequently took the cage in my hand to examine the spiders in sunlight. This did not disturb them. I again saw the separation. The embolus, stretched taut, for about 1½ inches, was withdrawn with some diffi-

culty. The left palpus was then preened. I saw its application at 5.25 p.m.-10.15 p.m.

April 3rd.—R.P., 12.30 p.m.-2.15 p.m. I did not see its application, which may have been considerably earlier. The same palpus was applied 2.25 p.m.-5.15 p.m. The spiders were photographed out of doors in full sunshine at 3.45 p.m., while copulation was in progress. They were not disturbed. The distensions of the haematodocha were still large, the cup travelling round the base of the palpus quite as vigorously as at the commencement of copulation.

April 4th.—No copulation. Spiders close together.

April 5th.—R.P., 12 noon-2.15 p.m. I did not see its application. L.P., 2.15 p.m.-4.30 p.m. Again I missed the application, but saw the embolus withdrawn, in three stages, with much effort, springing back, like elastic, into the palpus. R.P., 4.33 p.m.-8.25 p.m. I saw both application and withdrawal.

April 6th.—No copulation. Spiders always close together. On April 9, 10 and 11 the female took flies, her first meals since mating.

April 11th.—R.P., 5.15 p.m.-12.30 p.m. I saw application and separation.

April 12th.—L.P., 12.30 p.m.-3 p.m. I saw application and separation. L.P., 4 p.m.-11.30 p.m. I saw application and separation

April 15th.—Female took a Long-horned Grasshopper. The male did not attempt to touch it.

April 17th.—Courtship display in the morning. L.P., 6 p.m.-6.5 p.m. I missed its application, which was probably two or three hours earlier. Distensions of the haematodocha not quite so large.

April 19th.—L.P., 7.15 a.m. Still applied when I left home at 10 a.m. The spiders had separated when I returned at 4.45 p.m.

April 24th.—R.P., 1 p.m.-3.15 p.m. Distensions diminished. Female took a large Mantis. The male did not touch it. He had eaten nothing since mating. The female was still engaged on the Mantis while male endeavoured to apply L.P. from which the coils protruded. Frequent tremors shook his body as he rose on tip-toes and flipped his palpi. Copulation did not again take place. There were thus 18 periods of copulation, lasting for approximately 68¼ hours, in addition to other periods, which I missed. Great power of endurance is suggested. On three occasions the abdomen of the always-immobile female was bent back at right angles to the cephalo-thorax, supported only by the male tibial spur and a thread from her spinnerets, *while a palpus was applied, without interruption, for 7¼ and 7½ hours.*

It will be noted that there was not always a change of palpus between copulations, and that there was not always an interval between them, the male merely changing his position, the female remaining completely immobile while the change was made. In the latter case there was no separation of the spiders. There was very little courtship display, and this only by the male, after copulation commenced. Occasionally he passed his palpi over the dorsal surface of the female's cephalo-thorax a few times, but usually copulation took place without any preliminaries. It will be noted that he was still eager to copulate when greatly weakened.

April 26th.—The male took a fly, *his first meal since mating.* He took a second fly next day. The female was now avid, eating either flies or meal worms.

April 28th.—Female took a large mealworm. Male eager to copulate.

May 1st.—Female took a fly. Male immobile all day.

May 2nd.—Female took a Long-horned Grasshopper. Male still immobile.

May 4th.—Male preened palpi from which coils protruded.

May 5th.—Male still eager to copulate. Female took two flies.

May 6th.—Both motionless. A Woodmoth left untouched. The male seemed nearly lifeless. He moved slightly, only when touched. Often he rested on the female, probably a protective measure, although she at no time appeared to be hostile.

May 16th.—Male on floor in a tucked-in attitude. Appeared lifeless until touched, when he would stretch a leg.

May 25th.—Male still motionless on floor. Female suspended from the roof, apparently hibernating.

June 12th.—A fresh Woodmoth untouched. Earlier in their captivity this would have provided a night-long repast.

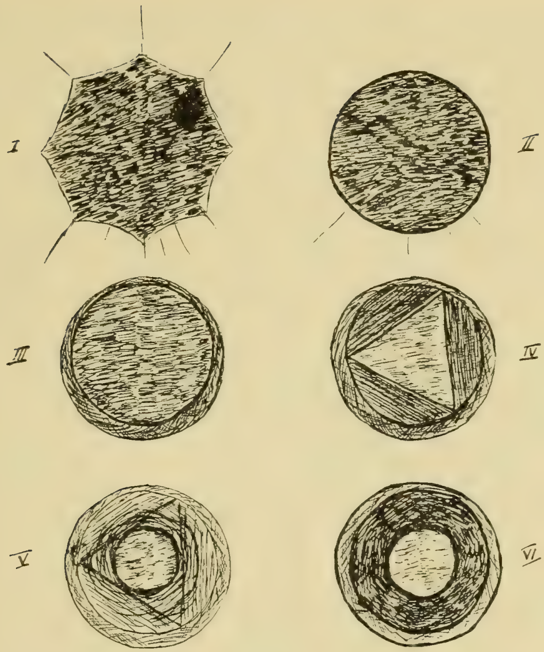
June 19th.—Male dead. In this way several of my male Huntsman-spiders have died. I suggest that it is the usual end of the male after he has served his species. He had eaten only two flies in the period during and following mating, whereas the appetite of the female increased greatly. Death appears to come very kindly. Resting on the roof of the cage the female hibernated until the end of August. No energy was lost in movement (nor was excrement voided), although towards the end of the month she occasionally stretched a leg.

August 29th.—Female spread and exercised her limbs at 4 p.m.

September 4th.—Female captured a fly, then seized the Woodmoth, *which had been placed in the cage on June 12th.* It was carried to the roof for a five-hour feast. This was the only occasion on which a spider accepted food not of her own slaying. She munched the dry moth with gusto. The word "munched" is really quite apt. Although Huntsman-spiders take the juices only of their prey, the bodies are squeezed and pressed between the chelicerae for many hours. Mealworms and the legs of spider victims are left like sawdust. From this date the female fed as usual. Indeed, like all females after impregnation, she was avid, a condition which is doubtless the cause of many tragedies. She had grown very corpulent. By September 25th she was too heavy to climb with her wanted agility. She spent much time on the floor, instead of suspended from the roof, probably because of her great weight. The tip of her abdomen dragged as she walked. Egg-laying was obviously imminent.

November 1st, 1937.—At midnight the spider was working on her egg-sac. A disc of silk, of close, smooth texture, was attached to one glass wall. It resembled a flat, muslin umbrella, the ribs (radii) not visible except near, and beyond the circumference. The latter was scalloped where the silk pulled upon the radii—like the fabric of an umbrella upon its ribs. The spider was moving round close to the margin with a sliding zig-zag motion, her spinnerets not elevated. This gave a smooth, ivory-like texture. She worked alternately clock-wise and anti-clock wise. The radii were invisible except where they ran to their points of attachment. I could not see how many had been placed for they were confused with other strands.

At 12 o'clock, the disc appeared as in the sketch (Fig. I). It was less perfectly circular than my diagrammatic sketches show it. The spider's



palpi appeared to play an important part in guiding, and preventing her from spinning beyond the disc. The size of the disc and the length of her body co-ordinated. Palpi and apex of the abdomen made the points of her compass. By removing the lid of the cage, I was able to view her work from within and without under a powerful electric light. At 1 a.m., she was no longer working with a sliding motion, but was spinning round the margin, with elevated spinnerets, pulling short lengths of flat ribbon-like silk before attaching them to the rim. As the ribbon touched the rim, it appeared to pull it in, much as one crochets—in the crown of a cap, to form the side. With elevated spinnerets and drawn-out ribbon-silk the scalloping disappeared. The rim had now a slightly thickened appearance as in Fig. II. The disc at this stage was an approximately circular lozenge, about 1 inch in diameter. By tilting the cage to view the work sideways, I could see that the spider was working only upon this thickened rim, the elevated spinnerets pulling a flat length of ribbon-silk of about 3 mm., before again touching the rim. The rim of the disc soon had the appearance of a low vertical wall, visible to the unaided eye.

At 2.15 a.m. the spider was taking longer rests. Her body just fitted over the shallow sac. At 2.45 a.m. the wall was about 4 mm. high, firm enough to support her weight (Fig. III). With elevated spinnerets and broad ribbon-silk she then crossed the sac in three directions, leaving a triangular open space in the centre. With spinnerets still elevated, she filled in the three outer, semi-circular sections, until they were covered with strands of ribbon-silk, as shown in Fig. IV. The structure was now a shallow sac with a triangular opening in the roof. *With ribbon silk she now worked right round, over the corners of the triangle, until only a small circle in the centre of the sac remained unroofed* (Fig. V). With spinnerets lowered she

went over the corners of the triangle, warp and woof, until they were covered, like the rest of the sac, with coarse, muslin-like silk, as in Fig. VI. She had completed her sac, except for a small circle, *the roofing of which was presently to enclose her eggs.* No seam was visible because there was no seam. *The sac was one continuous piece of work, not two, base and lid, as in Lycosidae and other families.*

The spider was now moving slowly, as if exhausted, resting for longer periods, sinking down on the nearly completed roof of the sac, *which became concave with her weight.* The muslin which covered the sac, except for the central hole, was still open in texture, semi-transparent, so that when, at 3.13 a.m., she crouched down, like a hen on its nest, I could see the sac filling out with green, spherical eggs (over 300!), dark green where the muslin was thin paler green where it was of closer texture. *The roof was now convex* with the bulging of eggs, even with the spider's weight upon it. In two minutes the stream of eggs had been deposited and the spider was covering the circular opening with ribbon silk. Her abdomen was greatly shrunken, narrow-oblong, instead of rounded in shape. She now went over the whole of the roof, brushing it with sliding, zig-zag motion, spinnerets not elevated, which gave a smooth, papery finish. The green of the eggs could still be seen when I switched off the light at 3.30 a.m. The spider was still working at 4 a.m. I did not look again until 7 a.m., when she was resting. The sac was opaque, but the green of the eggs could still be seen when the cage was held up to the light. At 1.15 p.m. the spider commenced to spin on the wall about the sac as if to anchor it more firmly. At intervals all day she went over the sac with lowered spinnerets. Thereafter she rested on the sac, as if brooding, leaving it only, when the eggs began to develop, to place a maze of silken lines in the corners of the cage. She did not eat, although other spider-mothers in my cages have occasionally taken a fly. Flies were merely killed, as if to safeguard her sac. She reached out smartly if one came near the precious cradle. Many times each day she went over the sac with tapping palpi, touching it so gently that one assumed the palpi were extremely sensitive. Doubtless, they conveyed to her what was taking place within the sac. Indeed, they are probably a means of communication, not only with her spiderlings, but with other adult spiders. In four days the still swollen sac was evidence that the eggs were developing. If infertile they soon shrivel, and the roof of the sac sinks. In 10 days the spiderlings had emerged and much movement could be seen when the cage was held up to the light.

Emergence of Young.—On December 2nd, at 8 a.m., the mother spider was tearing minute pieces of silk from the centre of the upper surface of the sac. At 10.30 a.m. she had pierced a small hole which she gradually enlarged. *She then inserted a palpus with which she pressed out the roof of the sac.* She could thus continue to enlarge the hole without harming the spiderlings. The silk was obviously very tough, and some effort was required to tear it. Often she jerked the cage so that the lid jingled. It would not, I think, be possible for the spiderlings to release themselves, as suggested by Froggatt (Aust. Spiders, p. 60). (To test this I removed from two mothers their sacs in which spiderlings were seen to have emerged from the egg-membranes. They lived for two weeks, but died within the sacs). The spider continued to tear the opening until several spiderlings had emerged, when she made a second, smaller hole. The young emerged at intervals until, next morning, there were several scores. On the sac and on the surrounding silken threads, there were about the same number of exuviae. I watched the moulting under a lens—a pretty thing to see. Suspended by

its spinnerets, the spiderling stretched its legs straight forward; waved, spread and closed them together a few times. It seemed impossible that other legs could really be enclosed within the delicate, translucent limbs, yet, in fifteen minutes, the spiderling had crawled out, backward, and was preening the new limbs. By December 8th the sac was covered with a dense mass of spiderlings, the mother brooding them like a hen with chicks. They were all about her, crowding between her outstretched legs. As she gently touched them with her palpi it was easy to believe that she was "talking" to them. With the seething masses of spherical, green abdomens and translucent legs about her the quiet mother made an exquisite picture of spider-maternity. The lid of the cage had been lifted. The family was free to depart if it wished. Instead, near the opening, the mother spun another maze of silken lines, to replace those which the removal of the lid had broken. On these threads the spiderlings exercised. At the lightest breath the mass became active, spreading into living waves of green and grey, to reassemble when all was quiet. By December 10th the spiderlings had lost their pretty green tints. The sac and the surrounding silk were now of a dingy-brown colour. Day after day the spiderlings surrounded their almost immobile mother. Soon a few, more daring than the rest, ventured farther afield, not always to return. By January 5th the number had diminished to 50. Two days later there were but 5, with the mother still on guard. I removed the sac for examination. It was half filled with egg membranes and tiny, iridescent exuviae.

Female's Second Mating.—On January 7th, 1938, I gently placed an adult male Huntsman-spider in the cage with the deserted mother. There followed the most beautiful courtship display I have seen. The sparring, fencing, parrying, thrusting, and side-stepping, were delightful to watch. Copulation took place on January 28th, 29th, and 30th. The appetite of the female increased, as before, after impregnation. At the present date (June 14th), male and female are still together. The female appears to be pregnant but will probably defer egg-laying until after the winter. The male has taken no food for some weeks. He will no doubt soon pass gently into his last sleep.

General Notes.—The courtship, mating, egg-laying, etc., of other Huntsman-spiders have differed little in essentials from those of the foregoing pair. It will be noted that the above female, although mated in March, 1937, did not make her sac until November 1st, whereas a second female, mated October 16th, made her sac a month later (November 28th), the young emerging on December 24th. The spiderlings in a third sac, constructed October 20th, could be seen breaking from the eggs on November 20th, and had left the sac on November 30th. At the present time, June 14th, four females, with greatly distended abdomens, which were mated in February and March of this year, are deferring egg-laying until spring. Three of these have already brought out a brood and have been mated again.

The final moult of the adult is even more beautiful than that of the spiderling. It is completed in one hour, (occasionally a little less), from the first twitching leg-movements that herald this phase. Attached by spinnerets to roof, wall or floor of the cage, the spider stretches its legs beyond the cephalo-thorax. It vigorously exercises each leg, waving it in the air, beating it on the wall or floor, as if to loosen it. The skin splits on either side of the cephalo-thorax. The carapace is lifted up, like a lid, as the spider crawls backward, sometimes upside down, out of the exuvia. If suspended upon the

roof, the spider may fall out of the old skin. The soft, fawn coloured body makes a striking contrast against the brown exuvia. The spider then crawls to the brown roof and rests until the new skin hardens, grooming its legs at intervals by drawing them through the chelicerae. The Huntsman-spider eats only when hungry. It may fast for a week or more, even when flies are available. It is a fine hunter, fearless, but cruel. A hungry female will hurl herself from the roof of a cage, sometimes landing on her back, to seize a fly. I have rarely seen one miss her victim. It is held between the falces of the chelicerae only, although palpi may be used to change the position of her prey.

On February 12th a special occasion provided more than adequate supplies. Males, as well as females, held several flies in a bunch. A female would stand on her head, with revolving abdomen, as she swathed a bunch of 5 blow-flies. The males managed to hold three flies without tying them. In capturing moths or grasshoppers the spider's sensitive legs are spread widely so that fluttering wings or kicking legs do not touch them. In the illustration of a Huntsman-spider eating a mealworm it will be seen that its awkward shape necessitated the support of her palpi. It will be noted, too, that the male spider makes no attempt to wrest the booty from her; nor have I ever seen one do so, even if he were hungry. (Plate xvi., fig. 1.)

After a meal, the palpi and legs are groomed by being drawn, with a nibbling action, through the chelicerae. The palpi, too, are used like hands in cleaning the cephalo-thorax as far as they can reach. This action is very pretty.

Regarding the Spider's Evil Reputation.—On October 10th, 1937, a nearly-mature female Huntsman-spider was enclosed with a small, but adult male. The female had not experienced her final moult. Two hours later she was dead, gripped between the falces of the male's chelicerae. Hunger was not the cause, for there were flies in the cage. Wishing to ascertain whether he would eat her, I did not disturb them. He remained in this position for 6 hours, then dropped the unmutilated body upon the floor. Had I not seen her gripped between his falces I should have assumed that she died a natural death. This, however, cancels out, for the male was afterwards mated with an adult female which had hibernated over the winter, in one of my cages. He paid the extreme penalty. His discarded body was munched and mutilated in her 24 hour-gruesome feasting. The legs were reduced to dust. The feast over, she at once captured a fly, and another while still holding the first. She made her egg sac on November 28th. The swollen sac betokened fertility. This sac swung from the roof. It was surprising that a few threads could support it, as well as the heavy female. On January 5th, 1938, her spiderlings emerged. This mother must have been caught napping, for the usual silken blanket had not been prepared. *No ground sheet was spun by any of my Huntsman-spiders,* but as soon as the spiderlings stirred within the sac, sometimes a little earlier, the mother spun a few threads, from sac to walls of the cage, adding to them daily, although she did not leave the sac for more than a few minutes. This is really the spiderling's layette. As the small active bodies slip through the opening, torn by the mother, they run along the maze of silken threads, on which many delicate iridescent exuviae are presently seen. But in this instance only a few threads were ready and the mother now hastily repaired the omission. It was pretty to see how carefully she moved over the sac, with body elevated, feet always placed where no spiderling would be trodden upon. To see this only, one is well repaid for the trouble of caging

a Huntsman-spider or two. Three other sacs have been similarly suspended. Others found hanging in the garage, or shed, under the bark of trees, or even under old sacks, support the view *that no ground-sheet is spun by this species*. Sometimes a few threads form a rough scaffolding, at other times the sac is constructed on the geometrical lines of a garden spider. Three of my spider-mothers left the sac when their spiderlings had departed. The lids of the cages had been lifted, so that they might do so if they desired. Others were placed in fresh cages with adult males. One mother, found suspended with her sac from the roof of a shed, was caged. She re-hung her sac from the roof of the cage. This mother left the sac after brooding for six weeks. There were 325 infertile, shrunken eggs within the sac. She was mated again with two other adult males. The first she killed and devoured (February 1st, 1938). She made a second sac (February 26th). Again the eggs were infertile. She settled down happily with a third mate and there were many beautiful courtship displays—some of the best I have seen. The male, however, outlived her. She died, March 11th. The male, mated with another adult female, is still alive, but is not taking food. He, too, will soon die.

It will be noted that the male, as well as the female, will kill a mate in certain circumstances, although I have not known him to devour his victim. I suggest that, under natural conditions, these tragedies are less frequent than is generally believed. Remembering the pairs of friendly Huntsman-spiders in my cages, resting day after day with legs intermingled, I feel that the black mark against the female is not altogether merited, and that extenuating circumstances may usually be pleaded when tragedies occur. The female is so avid after impregnation that her attack on the male is, doubtless, an answer to maternal instinct. With perhaps 350 eggs to mature, a cradle to spin, as well as a layette, food must be procured. If the male press further attention at a time when the female has other demands upon her bodily functions, he will be sacrificed on the altar of motherhood. Nature is indifferent to the pain of the individual. It is the species she guards. The sketches on page 185 were made as I watched the spider at work on her sac. I have copied them faithfully, without attempting to improve them as regards perspective; nor have I shown the confused radii and other lines. Some of these will be seen in the photographs. My construction lines are inked in boldly in order to show the spider's manner of working; but, in reality, the whole of the work is of smooth, even texture, in which no line is more definite than the others.

Summing up, it will be noted that the spider does not oviposit as soon as she has made the base of her sac, as in *Lycosa, Epeira* and others, but waits until the sac is completed except for a small circular hole in the roof through which she oviposits, crouching down for the purpose, like a hen on its nest. It will be noted, too, that no ground sheet is spun. The maze of silk threads surrounding many sacs is always, I think, placed there after the sac is completed, *when the spider is aware that the eggs are developing. I have seen no "layette" covering a sac of infertile eggs.* Many sacs are suspended, or attached, by a few threads only. These lightly-anchored sacs, to which the mother clings so tenaciously, are, I think, responsible for an impression that the Huntsman-spider carries her sac about with her, whereas she rarely moves during brooding, a period of about six weeks.

EXPLANATION OF PLATES.

Plate xvi. Fig. 1. ♀ and ♂ described in text (April 28th, 1937). Note that the ♀ is using her palps as fingers to keep mealworm in position. (Photographed through glass of cage.)

Fig. 2. Attitude before mating, when not displaying or feeding. Note that the epigynal aperture of ♀ is not yet exposed.

Plate xvii. Fig. 1. A suspended sac; no blanket spun. Attitude of ♀ when brooding. Instancing immobility of ♀ this photograph was given 11½ minutes' exposure.

Fig. 2. The same showing hole in sac torn by mother for emergence of spiderlings. (Note the inadequate blanket.)

Plate xviii. Further stage showing emergence of spiderlings and increased blanket accommodation, additions being spun by the mother without treading on the young.

REVIEW.

The Molluscs of South Australia.—By Bernard C. Cotton and Frank K. Godfrey. Part I. Pelecypoda. Price, 7/6.

When will the people of New South Wales see such a fine work on their Molluscs as that under notice? It is a member of a series of Handbooks of the Flora and Fauna of South Australia, issued by the South Australian Branch of the British Science Guild. There does not appear to be a New South Wales branch; if there be one, it must be dormant, as certainly there is not the liveliness apparent in the South Australian Branch. So far there has appeared a classic work on Mammals by Wood Jones, an excellent account of the Fishes by Edgar Waite, who also provided an equally good one of the Reptiles and Amphibians. The Crustaceans have been treated in an acceptable manner by Hale, now the Director of the S.A. Museum. Then another enviable work by Howchin on the Building of Australia stands as a book of reference for all the States, though specially written from the South Australian viewpoint.

Now, let us examine this latest publication, the bivalves, and what do we see? An excellently printed work of 314 pages, illustrated with 340 pictures, some line, some wash, and some photographs, all well reproduced in the text on good paper. There is a good introduction, dealing with classification, distribution, collecting, dredging (with illustrations of dredges), preserving and economy. Then follow definitions of the animal and shell of a bivalve with the terms used in describing them. After this the whole of the South Australian bivalves are described and figured (one or two West Australian forms being introduced for comparative purposes). These descriptions are complete and by means of this work every South Australian bivalve should be easily named, as guides to all the higher groupings are provided with keys to genera and species. It is a pleasing matter to congratulate the authors upon a production which must be the envy of every conchologist in other States. It is further delightful to record that there can be no criticism in any way, matters of difference being of so little comparative importance that it would be absurd to suggest them. Due to the method of publication the price is so insignificant that everyone interested in Australian conchology can afford to secure a copy and not one should be without it.

RAY'S BREAM AND ITS ALLIES IN AUSTRALIA.

By Gilbert Whitley.

(Plate xix.)

(Contribution from the Australian Museum.)

The finding of Ray's Bream, a fish usually called *Brama raii*, in any part of the world is always noteworthy, as this interesting species is of sporadic occurrence. The type-specimen was found in England in 1681 and named after John Ray, the famous naturalist of the time. In the intervening two and a half centuries, numbers of this fish have been recorded, but it is still regarded as a rarity. Apart from the typical Old World form, several allied species have been described, but we have still much to learn regarding the growth-stages and the limits of variation in these fishes. Their taxonomy is consequently tangled, as I found when identifying a new species recently caught in New South Wales, so that a brief review of the family nomenclature is necessary. The Pomfret, Ray's Bream, or Castagnole, as it is called, belongs to the Series Bramiformes of Jordan's Classification of Fishes, 1923, p. 181, and the family Lepidotidae of F. de Buen, 1935 (*Bramidae*, olim.). This family embraces only a few genera or subgenera, to which a tentative key is here offered:—

A. More than seventy transverse series of scales on body (Sc. generally 80 to 90) .. .. *Lepidotus*.

AA. Less than seventy transverse series of scales on body (Sc. generally 40 to 60).

- B. Lateral line present. Scales smooth-edged .. .. *Eumegistus*.
- BB. No lateral line. At least some scales emarginate .. *Taractes*.

Other generic names have been proposed for fishes distinguished by having or lacking teeth on the vomer and palatines, having the caudal forked or lunate, the opercles denticulated or entire, and the ventrals inserted before or below the pectoral base. At least some of these characters are accounted for by changes with growth, so for the time being I recognize only the three genera in the above key, but list all the generic names hereunder so that they may be available to future students.

Genus Lepidotus Asso, 1801.

Lepidotus Asso, An. Cien. Nat. (Madrid), iv., 1801, p. 38. Haplotype, *L. catalonicus* Asso, from Spain.

Brama Bloch & Schneider, Syst. Ichth., 1801, p. 98. Logotype. *Brama raji* (Bloch), from Northern Seas (i.e., England), designated by Bory de St. Vincent, Dict. Class. Hist. Nat., iii., 1823, p. 260.
Not *"Brama"* Klein, Walbaum, and other non-binomial authors, also Valenciennes, Dict. Univ. Hist. Nat., ii., 1861, p. 730, a genus of Cyprinid fishes = *Abramis* Cuvier, 1816.

Lepodus Rafinesque, Carat. n. gen. Sicil., 1810, p. 53. Haplotype *Lepodus saragus* Raf., from Sicily.—*fide* Jordan, Copeia 49, 1917, p. 89.

Taractes Lowe, Proc. Zool. Soc. Lon. xi., December, 1843, p. 82. Haplotype, *T. asper* Lowe, from Madeira. Name spelt *Taraxes* by Day, Fish. Gt. Brit. Ireland, i., 1880, p. 114.

Tylometopon Bleeker, Nederl. Tijdschr. Dierk., iv., 1873, p. 133, and Arch. Neerl. Sci. Nat., xi., 1876, Syst. Perc. Rev., ii., p. 299. *Ex* van Bemmelen, MS. Type, *Brama raii* (Bloch)—*fide* Jordan, Gen. Fish.

Amblytoxotes Bleeker, Arch. Neerl. Sci. Nat., xi., 1876, p. 311. Orthotype, *Toxotes squamosus* Hutton, from New Zealand.

Argo Steindachner & Döderlein, Denkschr. Akad. Wiss. Wien., xlvii., 1883, p. 34, pl. vii. Haplotype, *A. steindachneri* S. & D., from Japan. Preoccupied by *Argo* Herrmannsen, Indicis Gen. Malac. Primord., i., 1846, p. 77, a Gastropod mollusc.

Collybus Snyder, Bull. U.S. Fish. Comm., xxii., 1904, p. 525, pl. ix., Fig. 16. Orthotype, *C. drachme* Snyder, from Hawaii.

Eumegistus Jordan & Jordan, Mem. Carnegie Mus., x., 1, December, 1922, p. 35. Orthotype, *E. illustris* J. & J., from Hawaii.

Lepidotus F. de Buen, Not. Res. Inst. Esp. Oceanogr., ii., 1935, p. 102, pl. xxiv., Fig. 48. *Ex* Asso, 1801. Not *Lepidotus* Agassiz, 1833, a genus of fossil fishes (fam. Semionotidae) or *Lepidotus* Leuckart, 1877, Vermes, both preocc. Not *Lepidotus* Petrie, Descript. Sociol, xi., 1925, Anc. Egypt, p. 38, which is possibly *"Lepidosteus" niloticus*. Also not *Lepidotus* Bosc., Nouv. Dict. Hist. Nat. ed. 2, xvii., December 27, 1817, p. 475, pl. E. 30, which is a Scombroid fish, *Lepidopus* Gouan, 1770.

The generic name *Brama* has been applied to both fresh and salt water "Breams" by authors, some, like Bleeker, having used it for both. However, F. de Buen has indicated that *Brama* (Ray's Bream) is synonymous with *Lepidotus,* which name is preferred here. The fossil fish genus *Lepidotus* Agassiz is preoccupied.

The typical species of the genus is the English Ray's Bream, whose primary synonyms are detailed below. An allied form from south-eastern Australia and New Zealand is *Lepidotus squamosus* (Hutton), and there are various nominal species from other parts of the world.

LEPIDOTUS BRAMA (Bonnaterre).

(Plate xix., after Willughby.)

"Brama marina caudâ Forcipatâ" Willughby, De Historia Piscium, 1686 app., p. 17, pl. V. 12. "In palude Middelburgensi prope Tesae fluminis aestu maris delatus, . . . *Septemb.* 18, 1681. Descripsit D. *Jo. Johnson."*

"Toothed Gilt-Head" Pennant Brit. Zool., ed. 4, iii., 1776, p. 243, pl. xliii., fig. 114. Near the mouth of the Tees, Yorkshire, England.

Sparus brama Bonnaterre, Tabl. Encycl. Meth. Ichth., 1788, p. 104, pl. 50. Fig. 192. English Seas. Not *Sparus brama* Bloch, 1791, preocc.

Sparus dentatus Berkenhout, Synops. Nat. Hist. Gt. Brit. & Ireland., ed. 2, i., 1789, p. 74 and ed. 3, i., 1795, p. 74. Britain. Evidently based on Pennant's Toothed Gilt-Head, but "9 rows of teeth" is an obvious misprint for "2 rows of teeth".

Sparus raii Bloch, Nat. ausl. Fische, v., 1791, p. 95, pl. cclxxiii. Northern Seas [= Yorkshire, England].

Lepidotus catalonicus Asso, An. Cien. Nat. (Madrid), iv., 1801, p. 38. Spain.

Sparus castaneola Lacépède, Hist. Nat. Poiss., iv., 1802, pp. 33 & 111. Atlantic Ocean.

Sparus niger Turton, Syst. Nat. (Linné), i., 1806, p. 789 and Brit. Fauna 1807, p. 98. Yorkshire (based on Pennant). *Id.* Fox. Synopsis Newcastle. Mus. 1827, p. 233.

Lepodus saragus Rafinesque, Carat. n. gen. Sicil., 1810, p. 54. Sicily.

Scarus imperialis Desmarest, Nouv. Dict. Hist. Nat., ed. 2, xvii., December 27, 1817, p. 480. *Ex* Cupani MS., Sicily. Same as *Lepodus saragus* Raf.

Brama marina Fleming, Hist. Brit. Anim., 1828, p. 210. Type-loc. hereby designated: Mouth of the Tees, England.

Brama pinna-squamata Couch, Zoologist, vii., 1849, p. xxvi. Cornwall.

Chaetodon umbratus Machado, Cat. Pesces Cadiz., 1857, p. 23. Spain.

Brama raii of authors.

The above list is a chronological arrangement of the primary synonyms of Ray's Bream, the full bibliography of that species is too extensive for quotation. The species is usually, but wrongly, termed *Brama raii* since there are two specific names earlier than *raii* and the one to be used is *brama*. Several nominal species of "*Brama*" and even *Taractes* may be the same as Ray's Bream, but for the present they are listed as nominally distinct, as follows: *agassizi* Poey, *asper* Lowe, *australis* Cuvier, *brevoorti* Poey, *chilensis* Gay, *drachme* Snyder, *dussumieri* Cuv. & Val., *illustris* Jordan & Jordan, *japonicus* Hilgendorf, *leucotaenia* Fowler, *longipinnis* Lowe, *orcini* Cuv. & Val., *platycephalus* Matsubara, *princeps* Johnson, *raschi* Esmark, *saussurii* Lunel, *squamosus* Hutton, and *steindachneri* St. & Död.

Thus Ray's Bream and its allies have been recorded from England, Europe, including the Mediterranean, Madeira, North and South America, and the West Indies, South Africa, the Indian Ocean, Philippines, Japan, and Hawaii, Australia and New Zealand. The Australian Museum has specimens of *Lepidotus squamosus* from Lord Howe Id. and a small *Taractes* sp. from Erromanga, New Hebrides, which is withheld for future study. The latter has been recorded as *Brama raii* by Fowler (Mem. Bishop Mus., xi., 1934, pp. 400 and 423).

LEPIDOTUS SQUAMOSUS (Hutton).

Choetodon sp. Taylor, Te Ika a Maui., ed. 1, 1855, p. 410 and ed. 2, 1870. p. 628, Fig. —. New Zealand.

Toxotes squamosus Hutton, Ann. Mag. Nat. Hist. (4), xvi., November 1, 1875, p. 313 and Trans. N. Zeal. Inst., viii., May, 1876, p. 210. Cook Strait, New Zealand. *Id.* Flower & Bean, Bull. U.S. Nat. Mus., 100, viii., 1929, p. 34.

Brama raii Castelnau, Proc. Linn. Soc. N.S. Wales, iii., 1879, p. 352 (Sydney N.S. Wales) and of Australasian authors, not of Bloch. *Id.* Waite, Edible Fish. N.S. Wales, 1908, p. 10. *Id.* Phillipps, N.Z., Journ. Sci. Tech., vii., 4, 1924, p. 246, fig. — (New Zealand records). *Id.* Griffin, Trans. N.Z. Inst., lix., 1928, p. 378, pl. lix., fig. 4 (N.Z.). *Id.* McCulloch, Austr. Mus. Mem., v., 1929, p. 194.

Brama rayi McCoy, Prodr. Zool. Vict., dec. xiv., 1887, p. 127, pl. cxxxiii. (Portland, Victoria).

Brama japonica Day, Fish. Gt. Brit. & Ireland, i., 1880, p. 114. New Zealand. Not *B. japonica* Hilgendorf, from Japan.

Brama squamosa Speight, 46th. Ann. Rept. Canterbury Coll., 1918 (1919), p. 40 (New Brighton, New Zealand). *Id.* Bigelow & Schroeder, Bull. Mus. Comp. Zool. Harvard, lxix., 1929, p. 42.

Toxotes (*Amblytoxotes*) *squamosus* Weber & de Beaufort, Fish. Indo-Austr. Archip., vii., 1936, p. 195.

The Australasian representative of the English Ray's Bream, of which an excellent account and figure have been given by McCoy. It has been recorded from Victoria, New South Wales, New Zealand, and Lord Howe Island.

Mainly distinguished from the new species to be described hereunder by having eighty or more transverse rows of scales on the body and usually a couple of enlarged teeth near front of mandibles.

TARACTES MILTONIS, *sp. nov.*

(Plate xix., upper figure.)

Br. 7. D. iii., 33; A. ii., 24; P. ii., 19; V. i., 5; C. 20 et lat. brev. Scales 45 in longitudinal series, counting along the mid-line to last large scale at base of caudal; 15 above and 11 below the median series. Lateral line absent. 35 predorsal scales.

Head, body, scale, and fin characters agreeing excellently with the detailed description of the allied *Taractes princeps* (Johnson) recently given by Bigelow and Schroeder (Bull. Mus. Comp. Zool. Harvard, lxix., 2, February, 1929, p. 45 and plate —) but is of slightly larger size and is distinguished by having the eye-diameter about one-fourth, instead of about one-fifth the length of the head; anal lobe considerably shorter than head; comparatively longer pectoral and ventral fins; distance from ventral origin to anal origin notably less than length of head; different gill-rakers, etc.

Profiles of head and of interorbital space strongly convex. Opercles entire. Several rows of strong hooked teeth in jaws and on palatines; vomer edentulous. Eleven long spinose gill-rakers on lower part of first gill-arch. Pseudobranchiae well developed. Pectoral fin longer than head. Ventrals small, situated below pectoral base Anterior rays of dorsal and anal fins falciform, their posterior rays shorter and free from membranes, like finlets. Caudal fin lunate, preceded by deep scaled pits above and below.

Colour (in alcohol) largely smoky-greyish, relieved with yellowish on the centres of many scales. Fins mostly blackish, with yellowish-white tips to the finlet-like rays. Most of pectorals yellowish. Tips and bases of ventrals white; remainder black. A crescentic whitish margin to the black tail. Scales on fins iridescent pearly. Eye uniform light blue.

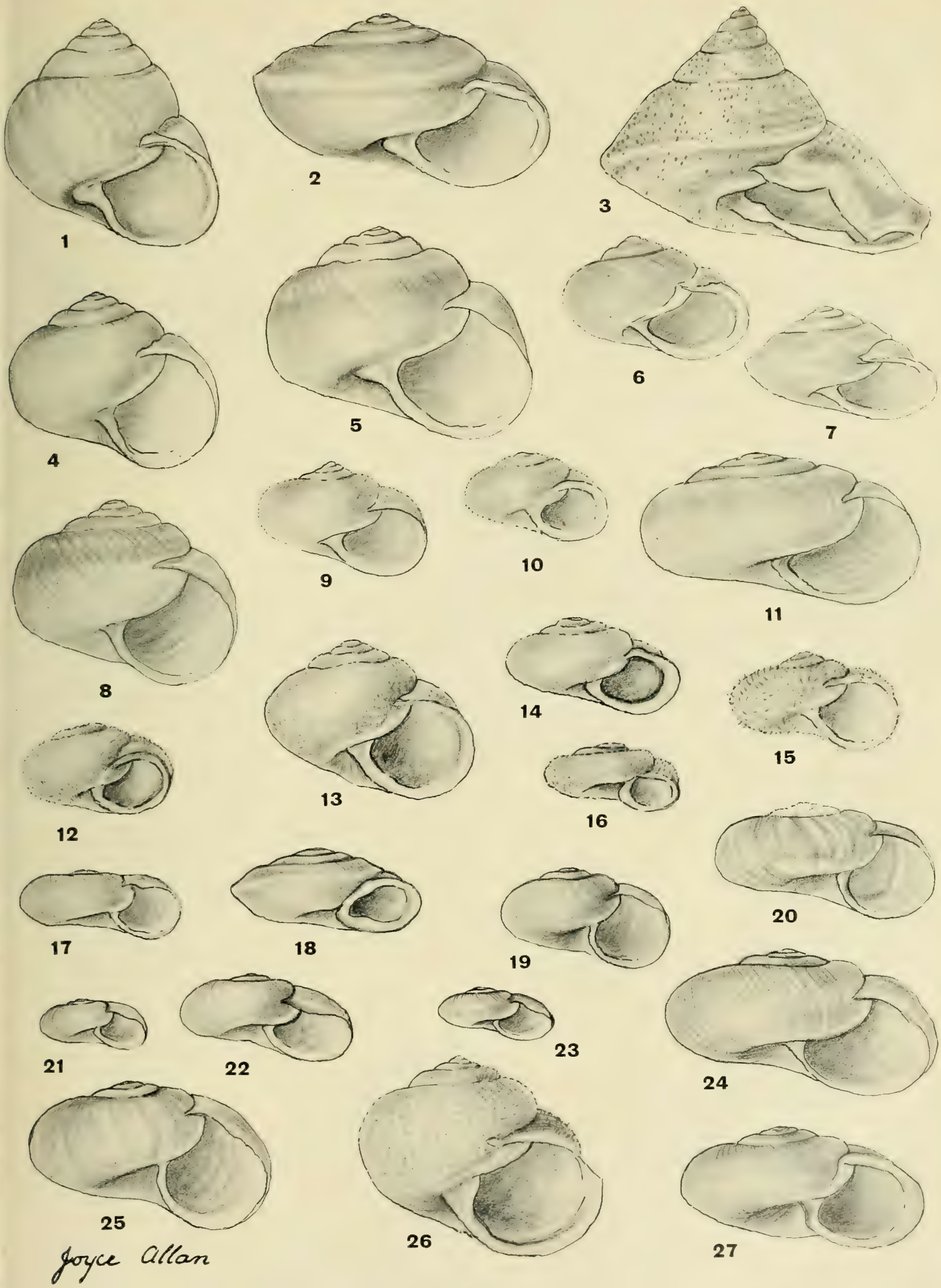
Described and figured from the holotype of the species, a specimen three feet in total length and weighing 29 lb. When received at the Museum, the tail had been separated from the body and the fish had been gutted and preserved in alcohol. Austr. Mus. Regd. No. 1A. 7695.

Locality.—Hooked on a crab bait off the rocks at a beach near Milton, southern New South Wales, early in September, 1938, by Mrs. J. Keane, and presented to the Australian Museum through Mr. T. C. Roughley, B.Sc., F.R.Z.S., of the Technological Museum, Sydney.

Table of measurements.—

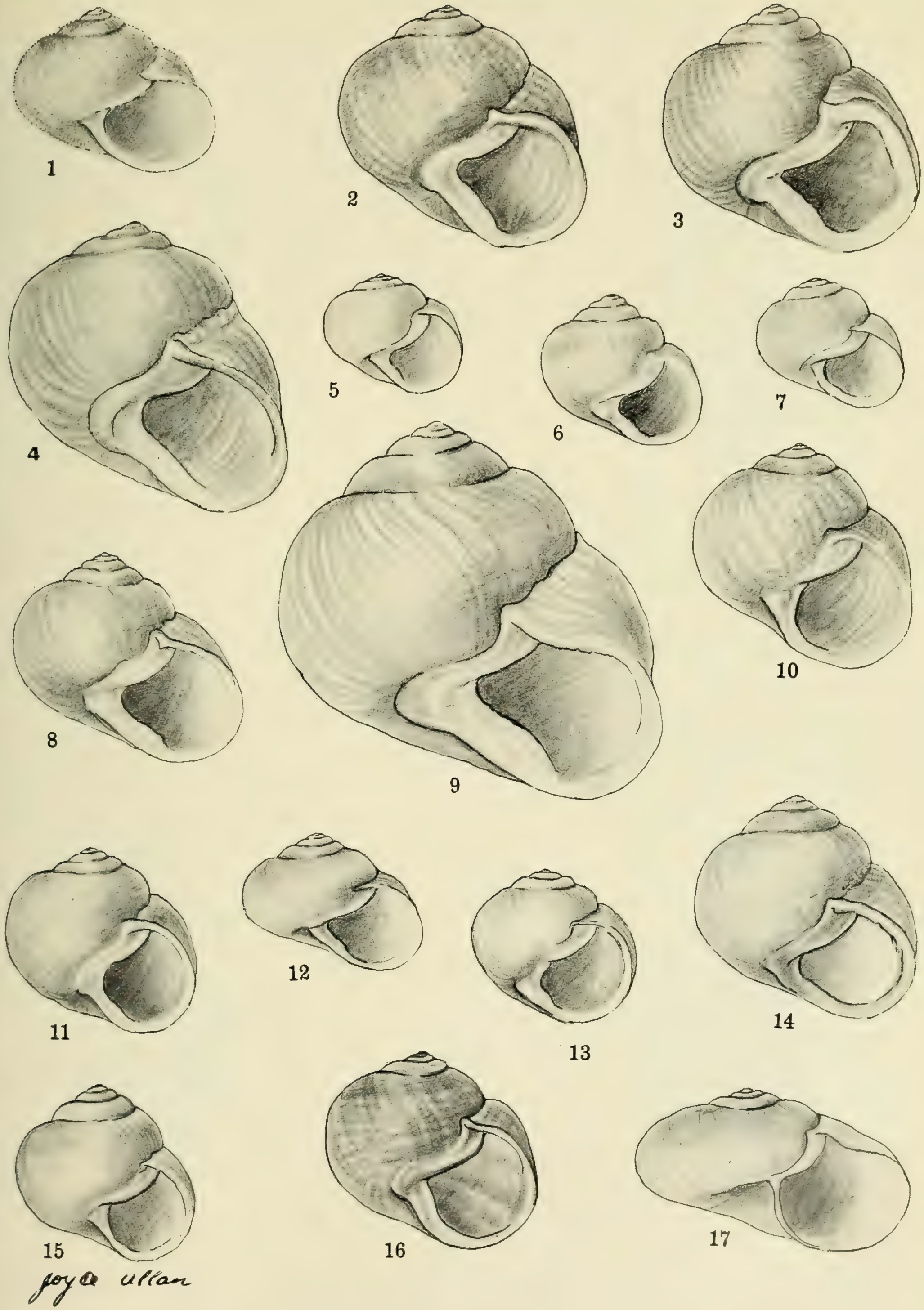
Length from snout to end of upper caudal lobe	915 mm.
Length to end of mid-caudal rays	780
Standard length (to last vertebra)	720
Depth	390
Head	200
Snout	50
Eye, horizontal axis	52
Eye, vertical axis	60
Interorbital	72
Least depth of caudal peduncle	45
Length of lower caudal lobe	200+
Length of upper caudal lobe	200+
Length of pectoral	258
Length of ventral	55
Ventral origin to anal origin	163
Height of dorsal	168
Base of dorsal	375
Height of anal	140
Base of anal	280
Upper jaw	99
Length of premaxillary	90
Postorbital	100

Anterior nostril 22 mm. before eye; posterior nostril 9 mm. long and 9 mm. from eye.



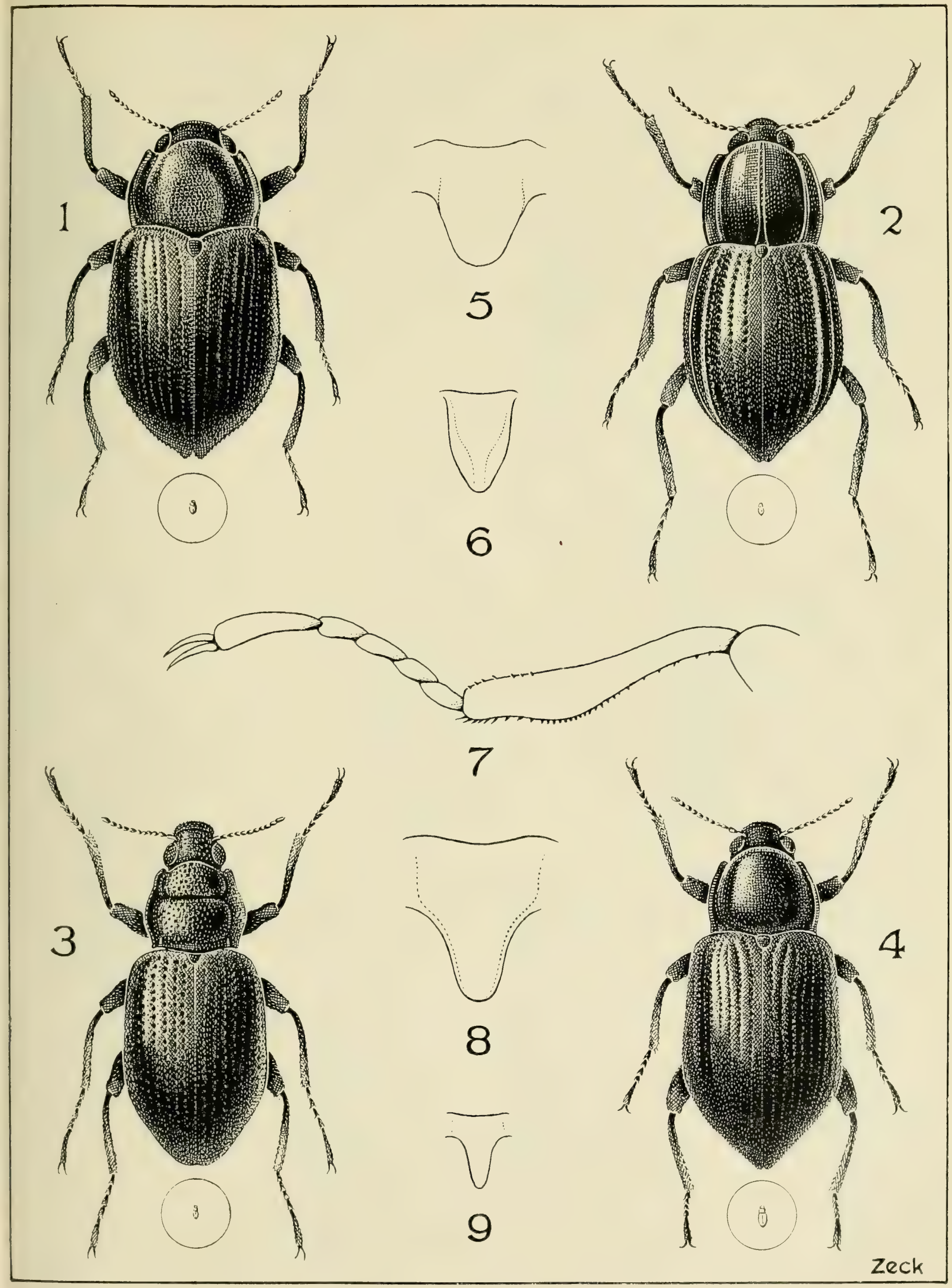
AUSTRALIAN LAND SHELLS.

Joyce Allan, del.



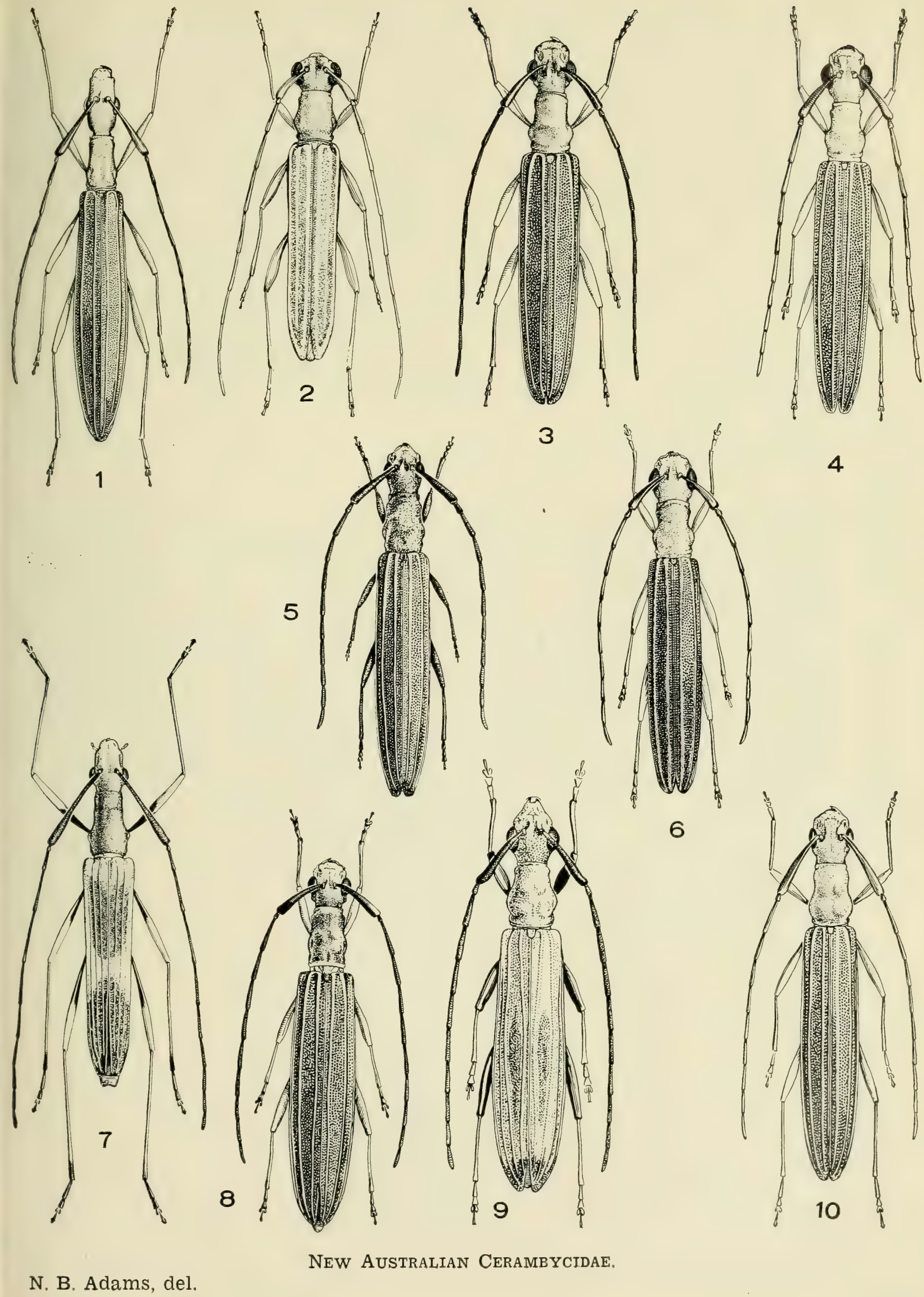
AUSTRALIAN LAND SHELLS.

Joyce Allan, del.



NEW AUSTRALIAN DRYOPIDAE.

E. H. Zeck, del.



NEW AUSTRALIAN CERAMBYCIDAE.

N. B. Adams, del.

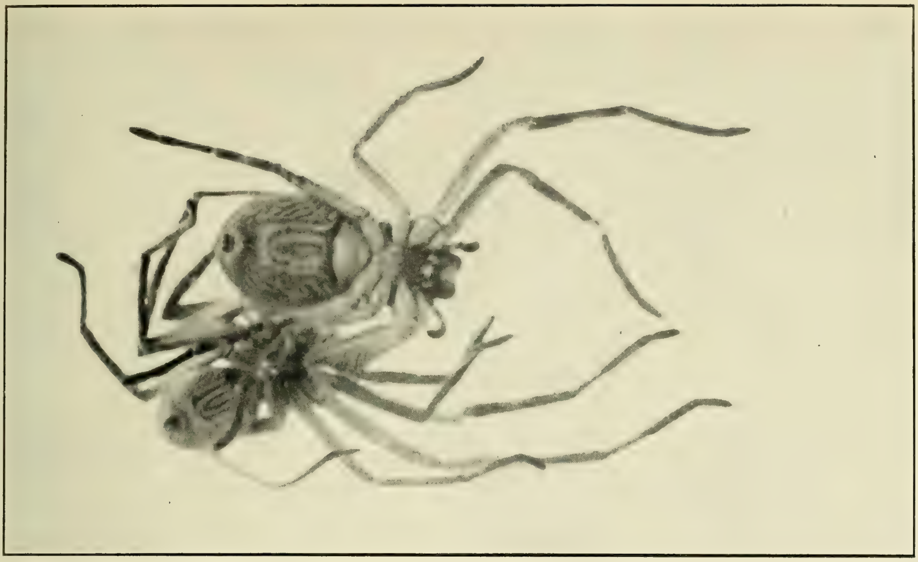


Fig. 2.

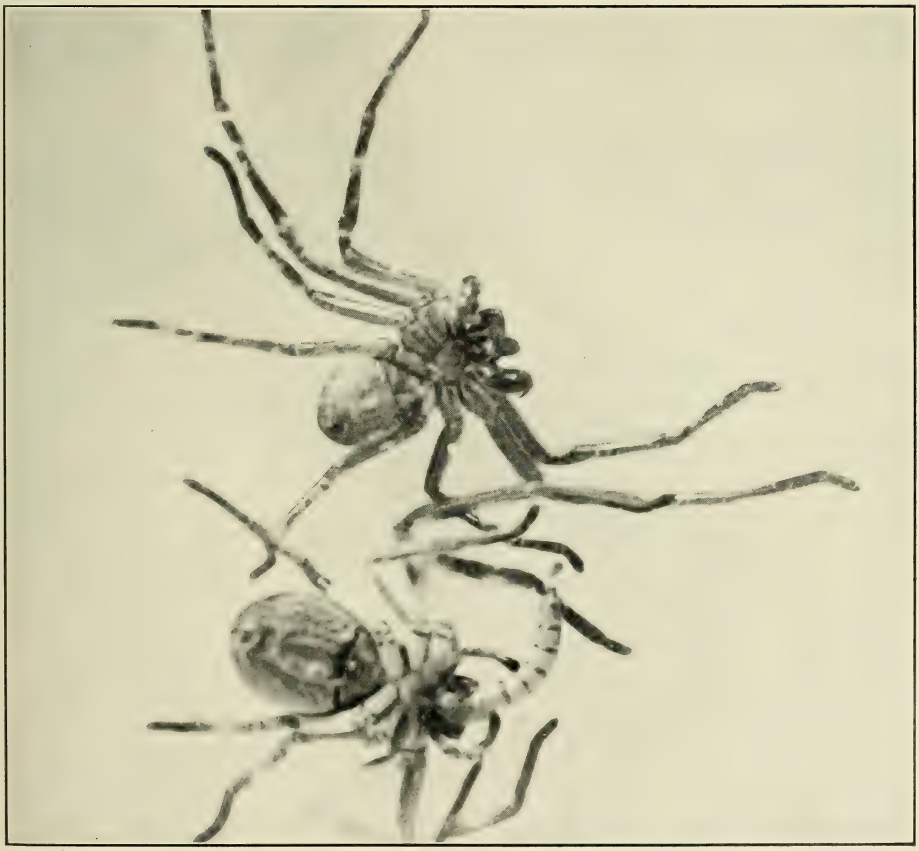


Fig. 1.

The Huntsman-spider (*Isopeda immanis*).

Photographs by Edith Coleman.

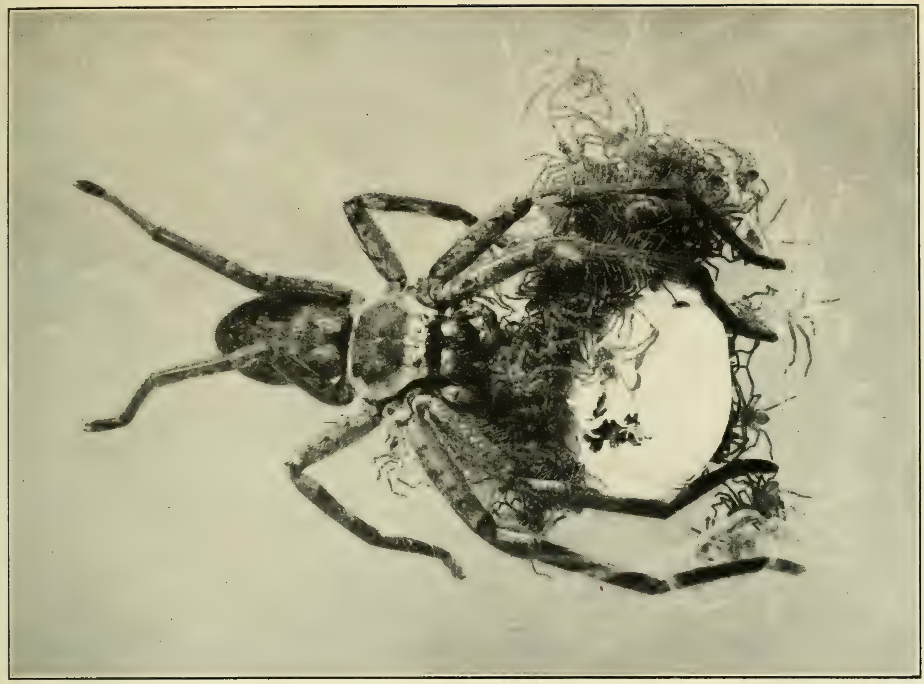


Fig. 2.

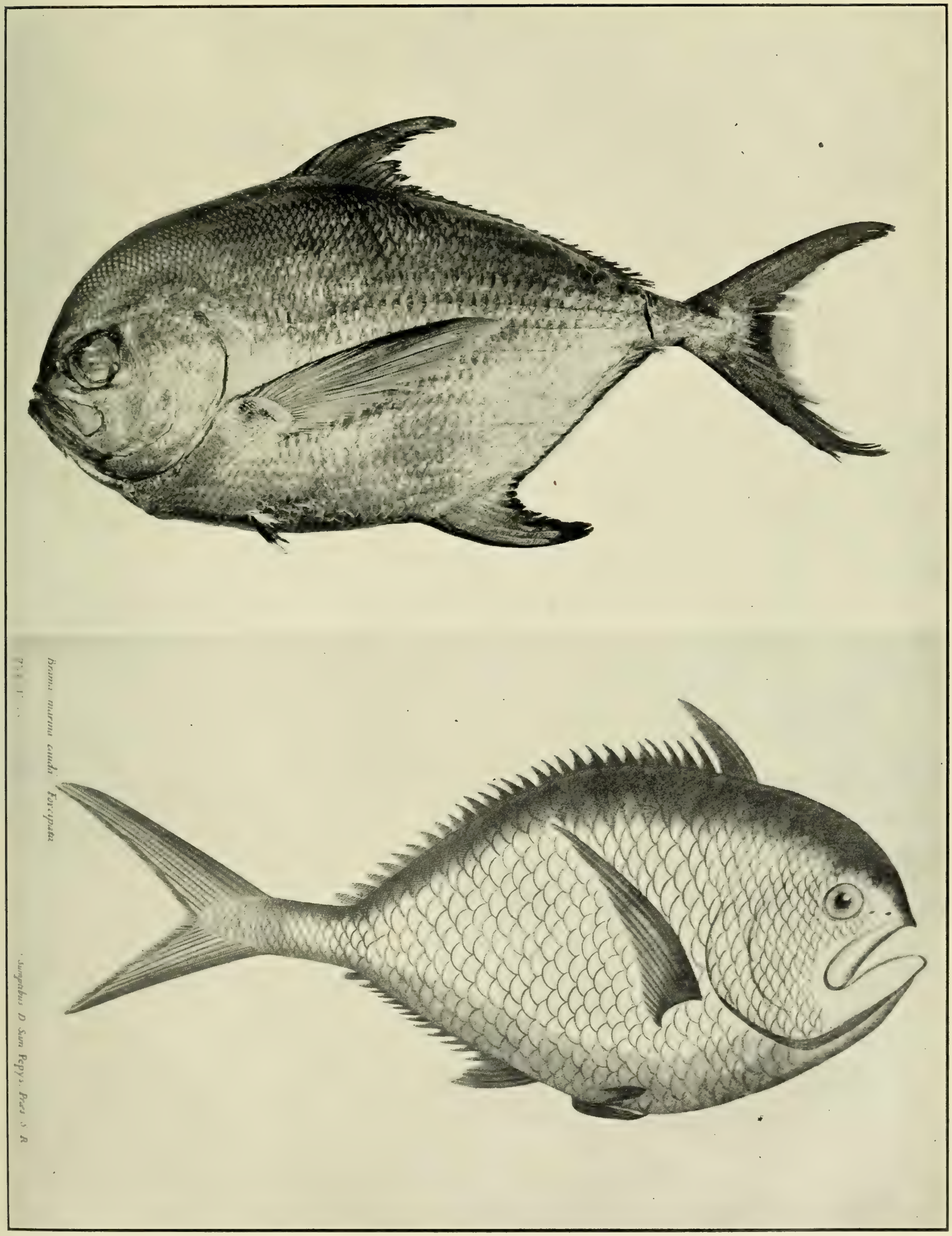
Fig. 1.

The Huntsman-spider (*Isopeda immanis*).

Photographs by Edith Coleman.

The Huntsman-spider (*Isopeda immanis*).

Photograph by Edith Coleman.



RAY'S BREAM.

Photographs by G. C. Clutton.

Royal Zoological Society of New South Wales.

MEMBERSHIP.

Class.	*Amount of Subscription.*
Associate Member	5 0 per annum.
Ordinary Member	£1 0 0 „

[Members joining after 1st January in any year pay one-half subscription.]

Life Associate Member	£2 10 0 in one sum.
Life Member	£10 0 0 „
Honorary Associate Member	No subscription. Elected for services to Australian Zoology or to the Society.
Honorary Member	

TITLES.

(Conferred by the Council.)

Fellow	For distinguished services to Australian Zoology.
Associate Benefactor.	For contribution of £100 to the Society's Funds.
Benefactor	„ „ £500 „ „ „ „
Endowment Members	„ „ £1,000 „ „ „ „

PRIVILEGES.

Members of all classes may attend all meetings of the Society and its various Sections. Every member (other than an Associate or Life Associate member) receives a free pass to Taronga Zoological Park and Aquarium, and twenty tickets each year, admitting 20 adults or 40 children to the Park only.

APPLICATION FOR MEMBERSHIP

should be addressed to the Honorary Secretary, Box 2399 M.M., G.P.O., Sydney, accompanied by a remittance of the amount of subscription. The number of Ordinary Members is limited to 350, and should there be no vacancy at the time of application, the applicant will be registered as an Associate Member, and shall take precedence in accordance with the date of his admission to Associate membership.

PUBLICATIONS.

"The Australian Zoologist"

A Journal containing papers relating to the Zoology of Australia. Published at irregular intervals. Subscription to ordinary members elected prior to July 1, 1933, 1/- per annum; ordinary members elected after June 30, 1933, and all associate members, 2/6 per annum.

Vol. No.	Parts.	Date.	Pp.	Plates.	Price (unbound). £ s. d.
I.	8.	1914-20.	256.	19.	1 0 0
II.	4.	1921-22.	172.	45.	12 6
III.	8.	1922-25.	362.	41.	1 0 0
IV.	6.	1925-27.	362.	49.	1 0 0
V.	4.	1927-29.	362.	41.	1 0 0
VI.	4.	1929-31.	394.	32.	1 0 0
VII.	5.	1931-33.	398.	23.	1 0 0
VIII.	4.	1934-37.	346	19	17 6
IX.	1.	1937.	82	11	3 0

Note:—Single parts of any volume may be obtained at published prices, less 20 per cent. to members or associates. Prices may be ascertained on application to the Honorary Secretary.

PUBLICATIONS (Continued).

AUSTRALIAN ZOOLOGICAL HANDBOOKS.

Check-List of the Fishes and Fish-like Animals of New South Wales, by Allan R. McCulloch, Zoologist, Australian Museum, 3rd Edition, with additions by Gilbert P. Whitley. 108 pp., 43 plates. Price, 2/6. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

A Monograph of the Australian Loricates, by Tom Iredale and A. F. Basset Hull. 168 + xiii. pp., 21 plates and portrait. Price, 5/-. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

Bibliography of Australian Entomology, 1775-1930, by Anthony Musgrave, F.E.S. 380 + viii. pp. Price, 10/-. Postage: Australia, 6d. British Possessions, 9d. Foreign, 1/6.

Australian Spiders and Their Allies, by W. W. Froggatt, F.R.Z.S. Price, 2/6. Postage: Australia, 1d.; British Possessions, 2d.; Foreign, 3d.

CONTENTS OF THIS PART.

"THE AUSTRALIAN ZOOLOGIST."

Communications intended for "The Australian Zoologist" should be typewritten.

Authors should state whether proofs and reprints are desired when submitting MS. Fifty reprints of any article appearing under a separate title will be supplied gratis. If more are required, terms may be ascertained on application to the Editor.

THE AUSTRALIAN ZOOLOGIST

Issued by the
Royal Zoological Society of New South Wales

Edited by
A. F. BASSET HULL, M.B.E., F.R.Z.S.

Vol. 9—Part 3

Sydney, December 12, 1939.

(Price, 10/-)

All communications to be addressed to the Hon. Secretary,
Box 2399 M.M., General Post Office, Sydney.

Sydney:
The Sydney and Melbourne Publishing Co., Pty., Ltd., 29 Alberta St., Sydney.

London:
Wheldon & Wesley, Ltd., 2, 3, and 4 Arthur Street, New Oxford Street, W.C.2.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

Royal Zoological Society of New South Wales.

Established 1879.

REGISTERED UNDER THE COMPANIES ACT, 1899 (1917).

Patrons.

His Excellency the Governor of New South Wales,
The Lord Wakehurst, K.C.M.G.

Sir Philip Woolcott Game, G.B.E., K.C.B., D.S.O.

A RECLASSIFICATION OF THE ORDER *ODONATA*.

BASED ON SOME NEW INTERPRETATIONS OF THE VENATION OF THE DRAGONFLY WING.

By R. J. TILLYARD, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.R.S., F.R.E.S.

CONTINUATION THEREOF.

By F. C. FRASER, Lt.-Col., I.M.S., Retd., M.D., M.R.C.S., L.R.C.P., F.R.E.S.

PART II.

The Suborders Zygoptera (continued), and Protanisoptera.

In this Part we take leave of the Coenagrioidea and, in doing so, note that they had attained to a stage of evolution in the Upper Permian which has remained practically static from then until the present day.

From the main stem of this superfamily, and most probably, from the Lestid complex, an important branch was thrown off, the *Megapodagriidae*. At what geological horizon this occurred it is difficult to say, but as the *Amphipterygidae,* which have descended from them were well advanced in the Jurassic, we may safely conclude that the *Megapodagriidae* originated early in the Triassic; the fossil record for the Odonata at this horizon is however entirely negative.

Because of this absence of fossil evidence, we are compelled to seek for the probable ancestors among the archaic forms which still exist today, and in doing so it is important to bear in mind the chief characters which separate the wings of the higher forms from those of the Coenagrioidea. In general, we note a marked advance in the type of venation; the system of cross-veins has greatly increased and, for the first time, we note that the two primitive antenodals no longer stand alone. The whole strength of the wing appears to have been dependent on a soundly built costal-antenodal complex from which the rest of the structures of the wing could be slung. The two primary antenodals appeared very early as an ordinal character in the venation of the Odonate wing, and along with the cross-nervure *Ac,* which has been fixed by the anal tracheal crossing, they have blazed a trail through the evolutionary history of the wing which it is necessary we should follow if we are to arrive at a correct interpretation of that history. I shall therefore devote a little time to the study of the primaries in the various families. (Fig. 1, A to G.)

The earliest appearance of the primary antenodal nervures, which have been termed by other authors—the "strong antenodals"—to distinguish them from the more weakly constituted "secondaries", is in the Protozygoptera of the Lower Permian. In *Sushkinia, Progoneura* and probably also in *Opter* (which is so poorly preserved that these nervures cannot be made out) we find the primaries in a very primitive condition; the costal and subcostal halves are approaching one another but have not yet come into alignment. They are two in number and are unaccompanied by any secondaries, save in *Progoneura,* where there is a single costal antenodal distal to the primaries. In *Kennedya* and also in *Permagrion,* which is an annectant genus lying between the Protozygoptera and Zygoptera, evolution has gone forward and the two constituent halves of the primaries are now in alignment. From now onwards, throughout the whole Order

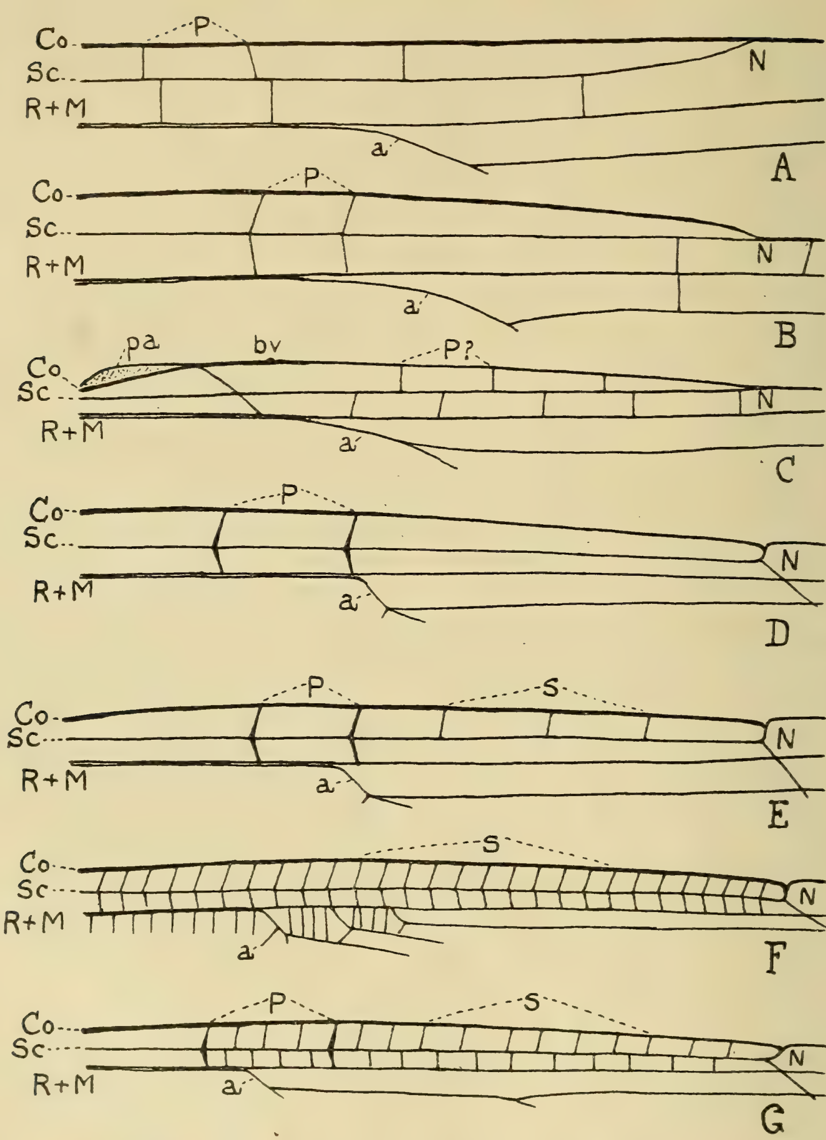


Fig. 1.—Evolution of the Costo-antenodal complex:—A.—Costal and subcostal antenodals not coinciding (*Progoneura* Carp., Protozygoptera). B.—Costal and subcostal antenodals now in alignment and forming the two primary antenodals (*Kennedya* Till., Protozygoptera). C.—Possible formation of primary antenodals in *Ditaxineura* Till. (Protanisoptera). D.—The primary antenodals completed (Coenagrioidea). E.—Secondary antenodals now present in the costal space, reinforcing the primaries (Amphipterygidae).

F.—Secondary antenodals in both costal and subcostal spaces and all in alignment. The primaries, at this stage, become obsolete (Agriidae). G.—Secondary antenodals in both spaces but not coinciding; primaries still present (*Epiophlebia* (Selys), Anisozygoptera). *P.*, Primaries; *N.*, Nodus; *a*, Arculus; *bv*, Brace vein; *S*, Secondaries; *pa*, Precostal area; *Co*, Costa; *Sc*, Subcosta; *R + M*, Radius plus Media.

Odonata, save in the most recent families, where their presence is concealed, the primaries exist as an ordinal character. More especially, we must note that *the proximal primary antenodal is the most basal of all the antenodals*, save in some very recent genera and species.

In the Protanisoptera, which will be more fully described below, we meet with a condition of the antenodal complex which is quite unique in the Order. From the apex of the precostal area an oblique vein runs distalwards, crossing the subcosta to meet the combined Radius and Media. (Fig. 1, C, *bv*.) It is analogous, if not homologous to the same oblique vein found in the Plectoptera. Both Dr. Tillyard and Professor Carpenter have fallen into the error of confusing this vein with the proximal primary antenodal, which it cannot possibly be, since the latter is never connected with the base of the wing and always situated well distal of it; moreover it is too oblique and shows no evidence of ever having been constructed from separate costal and subcostal portions. It has no analogy with the proximal primary found in the Protozygoptera and in the rest of the Order Odonata. In *Ditaxineura*, this oblique vein is followed, some way distally, by two costal antenodals and three subcostals, all spaced rather widely and alternating with each other at about equal distances. One or more antenodals are seen more distally but too far out indeed to take any part in forming the primaries. The primaries may, however, be developed later by a gradual coincidence of the two more proximal pairs? But if this did eventually take place, then we should expect to find them perfectly aligned in the much more highly developed *Polytaxineura* and *Pholidoptilon*. In the former, the 5th and 6th antenodals are aligned but appear to be no more highly differentiated than the rest; their alignment may be purely accidental as often happens when a great number of antenodals exist in either space, as is the case in *Polytaxineura*. In *Pholidoptilon* only one set are in alignment and these too far out to be the distal primary antenodal. It seems clear then that the primaries are altogether absent in the Protanisoptera, and that the absence of this important ordinal character stamps them as, not only a very early offshoot from the root of the Odonata, but, at the same time, altogether precludes the possibility of their being the ancestors of the Anisozygoptera and Anisoptera. Additional proof of this will be given when dealing with the Protanisoptera below.

In the Coenagriidae, the primary antenodals retain the condition found in *Permagrion*, and it is only when we arrive at the *Megapodagriidae* that we first meet with secondary antenodals. In *Trineuragrion*, a single subcostal antenodal is found distal to the primaries, and in *Neurolestes* a complete antenodal is found lying between the primaries.

It is only when we come to the *Amphipterygidae* that we find secondary antenodals supporting the primaries as a *constant* character. At first sight, very little seems to separate this family from the *Megapodagriidae*, but when we come to compare the venation of the two, we find that whereas *the postnodal nervures in the latter are in strict alignment with the cross-veins connecting Ri with Rii, they fail largely to coincide in the Amphipterygidae; this character is constant for the whole of the higher Zygoptera.*

It is convenient here to recall the fact that the postnodals in *Hemiphlebia* do not coincide with the cross-veins between *Ri* and *Rii,* but since it possesses neither intercalated sectors nor secondary antenodals, it cannot be included in either the *Megapodagriidae* or *Amphipterygidae*; its place seems to lie immediately adjacent to these two families in a family of its own, the *Hemiphlebiidae.* I do not think that there is sufficient justification to raise it to superfamily rank.

Dr. Tillyard, following other authors, has placed the two fossil genera *Dysagrion* and *Phenacolestes* in the *Megapodagriidae,* but since, in them, the postnodals fail to coincide with the cross-veins following them posteriorly, I now transfer them to the *Amphipterygidae* along with a number of other fossil genera detailed below under the description of this family. (Fig. 3, 1 to 6.)

In the genus *Philoganga,* belonging to this family, a new type of antenodal first makes it appearance at the extreme base of the wing, proximal to the proximal primary antenodal. (Fig. 4, 1.) These exist in the subcostal space only, but, as we shall see when we come to study more highly developed forms in both the suborders Zygoptera and Anisoptera, they tend to become complete. Along with this, the secondaries, from non-coinciding elements, become aligned to form complete cross-nervures, and when this is completed, the primary pair atrophy and finally disappear altogether. Out of this evolution, we are able to formulate the following axioms:—

(1) Species with only primary antenodals are more primitive than those with secondaries.

(2) Species with primary and secondary antenodals are more recent than those with only primaries, but more primitive than those with primary, secondary and additional basal antenodals.

(3) Species with the whole of the secondary antenodals in alignment and the primaries atrophied or obsolete, are more recent than all others.

These three axioms furnish us with a useful yard-stick with which to appraise the age and placing of any particular species, genus or family.

We may now resume the review of the general venation of the higher forms, and first, we notice that an important character is the formation of a number of intercalated veins or sectors between the distal parts of the main veins. This is already in evidence in the *Megapodagriidae,* but is further augmented in the *Amphipterygidae.* It is well illustrated in *Diphlebia* (Australia) and reaches its culmination in *Neurobasis* (Australia) of the Agriidae. (Fig. 4, 3 and Fig. 8.)

Of greater interest, from an evolutionary point of view, is the almost static arrangement of the branches of *Rs.* In the older Zygopterous types we noticed how the course of evolution was characterized by a progressive movement of the origins of these branches towards the base of the wing, culminating in the Lestid type in which both $Riv + v$ and *IRiii* arise close together and considerably nearer to the arculus than to the nodus. This Lestid condition for the origins of these two veins is *basic for the whole of the higher families of the Odonata, both in the Zygoptera and Anisoptera.* It will be seen to be attained in the Amphipterygid genus *Diphlebia* (Australia) and is so for the whole of this family, although not quite complete in *Philoganga* (Oriental). The conclusion at once suggests itself that the immediate ancestor of all the higher forms was one in which the

Lestid position of the origins of *Riv* + *v* and *IRiii* was well in process of attainment.

In the *Amphipterygidae*, we see therefore, clear cut links connecting the Coenagrioidea with the higher Zygoptera and Anisoptera.

From the *Amphipterygidae* arose a number of branches from which, ultimately, were developed the higher forms of the Zygoptera and the new suborder Anisozygoptera. It is probable that these branches were multiple and widely divergent in character, for the five primitive genera which have survived up to the present day differ to a remarkable degree, although agreeing in the fundamental characters of the costo-antenodal complex, proximal origins of the Riv + v and IRiii and the intercalated sectors.

Within the superfamily Agrioidea, which includes all the Zygopterous families from the Amphipterygidae upwards, there is no approach in the shape of the discoidal cell to the acute distal angle found in the Lestid complex, so that we are driven to search for ancestral types somewhere within the complex of ancient forms included under the family *Megapodagriidae*. Of these, the genus which most closely approaches the ideal is *Rhipidolestes*, in which the origins of Riv + v and IRiii have already attained much the same position as in *Philoganga* (*Amphipterygidae*), while the general arrangement of all the other main veins is closely similar and the discoidal cell is of the shape required in the ancestral form of the Agrioidea. But in *Rhipidolestes* the postnodals are in alignment with the adjacent cross-veins, a character quite unknown in the Agrioidea. We have therefore still to find a type possessing those features common to *Rhipidolestes*, but with the postnodals out of alignment with their neighbouring cross-veins. Such annectent forms are those of *Pseudolestes, Petrolestes, Phenacolestes*, etc., which bridge the gap between the Megapodagriidae and Amphipterygidae. *Pseudolestes mirabilis* Kirby, in its forewing, possesses all the characters necessary for the ancestral type of the Agrioidea. Thus I consider that a clear case has been made out for the evolution of this superfamily from a Megapodagriine ancestor related to *Rhipidolestes*, and an Amphipterygine one not far removed from *Pseudolestes*. (Fig. 2, 1 and 2.)

The evolution of the Anisozygoptera offers no such difficulty in the matter of the shape of the discoidal cell, since in all the genera, this cell,

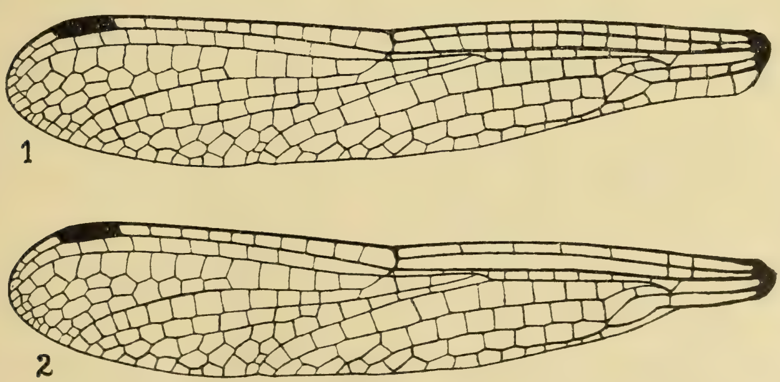


Fig. 2.—1.—*Pseudolestes mirabilis* Kirby. 2.—*Rhipidolestes aculeata* Ris.

in the forewing at least, is of a distinctly primitive Zygopterous shape. This suborder will be dealt with more fully in Part III.

A further point of interest in the evolution of the Agriodea is the structure of the arculus and the main veins arising from it. If we compare this region in a primitive genus such as *Diphlebia* (Fig. 4, 3), with that of *Austrolestes* (Fig. 18, Part I), we see that the general arrangement, including not only the positions of the origins of Riv + v and IRiii, but also their direction in relation to one another, are the same in both, the only important differences (apart from the shape of the discoidal cell) lie in the presence of a few secondary antenodals in *Diphlebia,* and in the more centralized position of the nodus, which increases its relative distance from the arculus. But in the higher types of the superfamily, two remarkable lines of evolution became manifest, neither of which has any counterpart in the other families of the Zygoptera.

The first of these two developments is that found in the family Polythoridae (Fig. 6, 2), confined to S. America, and consists of a recession of the short common stem of Rs + MA (or anterior arculus) right back to the Radius itself, so that the arculus becomes obsolete and the base of the discoidal cell becomes suspended, as it were, from the distal primary antenodal. Now in most of the genera belonging to this family, the proximal primary antenodal has disappeared; it is clear then that the distal one has been preserved to take the pull of the attachment of the discoidal cell; it has, in fact, taken the place of the arculus and is not only preserved but actually thickened and strengthened.

The second line of evolution is one which is not concerned with any change in the form of the arculus itself but begins with a strong anteriorwards arching of the vein Rii + iii, immediately after its origin from Rs. This can be seen in its most elementary stage in the genus *Libellago* (Chlorocyphidae) (Fig. 5, 3) *Rhinocypha tincta* (Queensland)). The next stage is an atrophy of the basal portion of Rii + iii, which, owing to the anterior arching, has come to lie in close proximity to Ri (Fig. 7). The final stage is reached in the highest forms (Fig. 8, *Neurobasis*), by a secondary fusion of the arched Rii + iii with Ri, and this fusion may last so long as to make it appear that both IRiii and Rii + iii have separate origins from Ri; it is only the persistence of the original common anteriorly arched stem from Riv + v as an *oblique vein* which gives us the key to the solution of this venational problem. In some genera and species, even the oblique vein has disappeared, so that without the aid of comparative anatomy, we could not arrive at the solution of the problem.

Throughout the Agrioidea, with but few exceptions, the females have preserved largely their primitive condition of uncoloured and similarly shaped fore and hind-wings, in striking contrast to the males whose development has gone ahead and along widely diverging lines. This, of course, has been the outcome of sexual selection, whereby utility or the power of flight has been sacrificed for the sake of appearances. Flight in the primitive Zygoptera is "sculling" in nature, as is well demonstrated in those species with dark banded wings (*Disparoneura quadrimaculata* (Rambur) and *D. apicalis* (Fraser)).

These species have a steady hovering flight and the combination of rapid sculling action of the wings with their dark transverse bands, produces a kinematic effect of dark circles suspended in the air. In the higher Zygopterous forms, the flight of the females is similar to that of

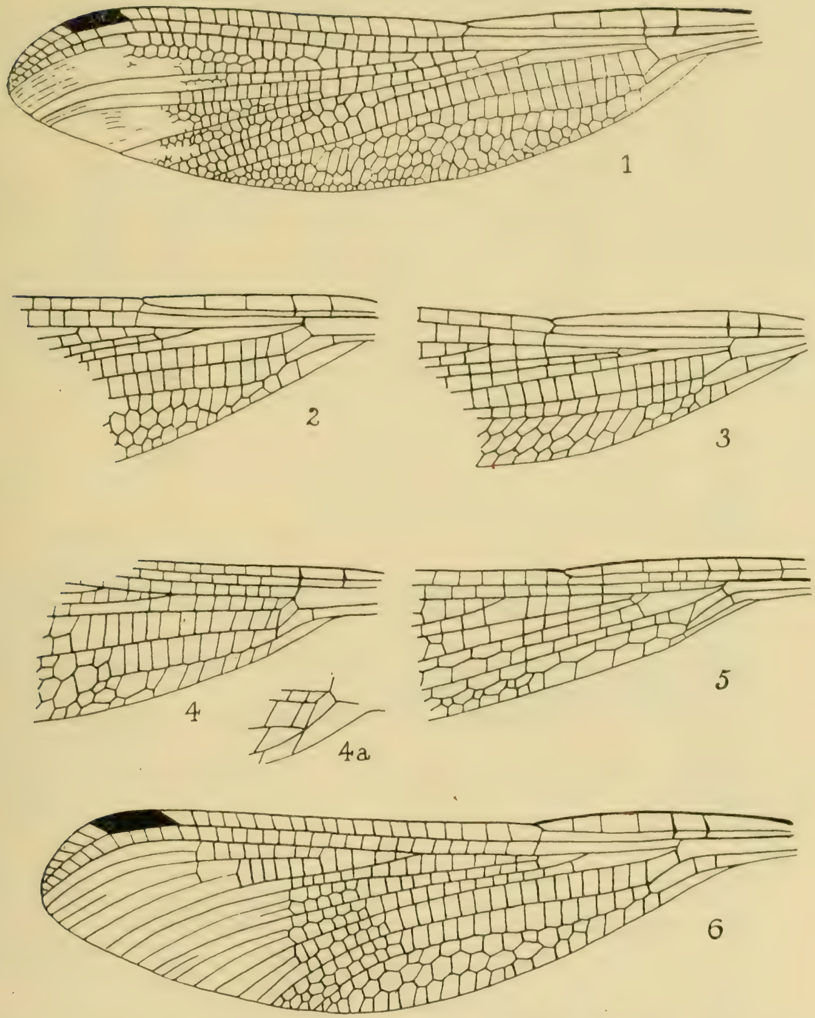


Fig. 3.—Possible ancestral forms of the higher Zygoptera and Anisozygoptera:—1.—*Dysagrion packardi* Scudd. 2.—*Dysagrion fredericii* Scudd. 3.—*Petrolestes* Cock. (Eocene, N. America). 4.—*Triassolestes* Till. (Triassic, Queensland). 5.—*Steleopteron*. Handl. (Jurassic, Bavaria). 6.—*Phenacolestes* Cock. (Miocene, N. America.).

the primitive forms, but in the males, owing to a broadening of the hind-wings and the need to keep these latter as motionless as possible to display their brilliant colouring to the female, flight is a combination of sculling with the forewings, which act as propellers, and planing with the hind-wings. We have frequently observed *Neurobasis chinensis* L. (Queensland)

in the act of pursuing a female, planing closely over the surface of a turbulent stream, rising over the crest of miniature waves and dipping into the trough between them, its forewings hardly visible, so rapidly were they beat, its hind held horizontally outwards with occasional slight alterations in their inclination so as to display their glorious metallic colouring to the best advantage. In this way, sexual selection has had a profound effect on the evolution of the Agrioidea.

In presenting a new classification of the Agrioidea, we shall, as in our previous studies in Part I, make use mainly of the wing-venation. Unfortunately, the larval characters, which would obviously be of the greatest assistance in determining the affinities of some of the more puzzling forms, are only known for a few genera, and hence the placing of such forms as *Devadatta, Heliocharis* and *Pentaphlebia* may be considered as still a matter for discussion. Apart from venation, the peculiar structure of the clypeus in the Chlorocyphidae and the great length of the legs in other families appear to be of great importance; lastly the structure of the genitalia is assuming yearly a greater value, as fresh studies are made of these organs.

The following key will serve to distinguish the families:—

1. Both primary antenodal nervures present; arculus present, discoidal cell well separated from Ri. .. .. 2.
   Both primary antenodal nervures absent; arculus present. .. .. 4.
   Only the distal primary antenodal present (except in *Euthore* and some species of *Cora,* where both are present); arculus absent. .. .. *Polythoridae.*
2. Rii + iii more or less arched towards Ri, shortly after its origin; secondary antenodals numerous. .. .. 3.
   Rii + iii not arched towards Ri; secondary antenodals few in number. .. .. *Amphipterygidae.*
3. Clypeus produced in the form of a prominent snout; no basal antenodals ever present. .. .. *Chlorocyphidae.*
   Clypeus not produced; nearly always basal; antenodals present. .. .. *Heliocharitidae.*
4. Rii + iii not usually fused with Ri, shortly after its origin; anal vein without a recurrent branch; discoidal cell short, usually shorter than basal space and either untraversed or traversed by very few cross-veins .. .. *Epallagidae.*
   Rii + iii nearly always fused with Ri for a short distance after its origin; anal vein with a recurrent branch or itself recurrent; discoidal cell elongate, usually as long as basal space and traversed by numerous cross-veins. .. .. *Agriidae.*

Family 1. AMPHIPTERYGIDAE. (Fig. 4, 1 to 4.)

The *Amphipterygidae* together with the *Megapodagriidae* consist of a number of rather indeterminate genera which bridge the gap between the Coenagrioidea and Agrioidea. They differ from the *Megapodagriidae* mainly, by the failure of the postnodal nervures to coincide with those cross-nervures lying between Ri and Rii and by the discoidal cell which, from an acutely pointed quadrilateral, becomes more definitely rectangular. In some genera, however, the discoidal cell is still acutely pointed outwardly, as in *Hypolestes,* etc. Another character, which first appears in the Megapodagriidae, although only occasionally, is established as a *constant*

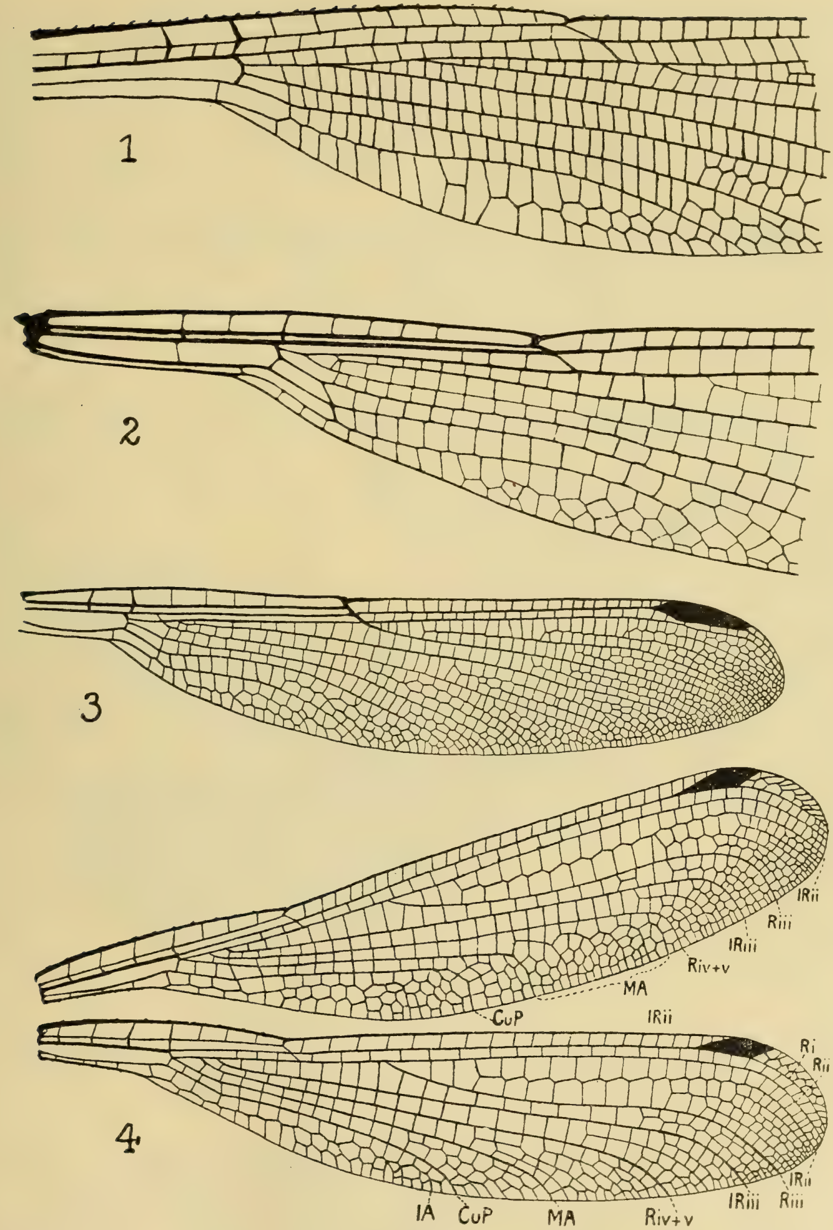


Fig. 4.—Amphipterygidae:—1.—*Philoganga loringae* Fraser (Oriental). 2.—*Amphipteryx agrioides* Selys (Neotropical). 3.—*Diphlebia lestoides* Selys (Australia). 4.—*Devadatta .argyoides* (Selys) (Oriental).

feature of the wing, viz., the presence of secondary antenodals to augment the primaries. These are usually confined to the costal space and distal to the primaries only. In *Devadatta,* however, the secondaries have extended into the subcostal space and four or five of them are in strict alignment, foreshadowing what we find in the Agriidae. The wings are still petiolated to nearly as far as Ac; the discoidal cell is a more or less elongate rectangle or subrectangle, entire or crossed by one or two veinlets as in the Epallagidae; the pterostigma is elongate and strongly chitinized. Of more importance are the first indications of a broadening of the wings as evidenced by a pectinate or wavy branching of the ends of the main veins, more particularly those of CuP and IA. This is strikingly demonstrated in *Devadatta argyoides* (Selys), where the venation of the forewing differs from that of the hind; the distal ends of the main veins of the forewing curve downwards abruptly in a series of waves, whilst those of the hindwing run almost flatly to the border of the wing. (Fig. 4, 4.)

This family contains medium-sized insects of moderate or robust build and having the general appearance of large stoutly built Lestidae; the head transverse with large, button-like eyes; the thorax robust, abdomen elongate and male anal appendages forcipate. In the position of rest, the wings, in some at least, are held wide open (*Diphlebia* and *Philoganga*) as in the Anisoptera. The only known larvae are those of *Diphlebia* and *Philoganga,* which are remarkably similar, in strong contrast to the perfect insects; they are found clinging to the underside of rocks in torrential streams, are flattened beneath, with short, flat labial mask having narrow lateral lobes without setae and ending in three distal teeth and a long, sharp terminal hook; the caudal gills are saccoid or triquetral and there are no lateral abdominal gills.

Pending the discovery of other larval forms, the relationships of the genera included in this ancient family must remain more or less problematical. The genus *Philoganga* differs more strongly from the rest and therefore merits the erection of a subfamily as has been done by Kennedy. The two subfamilies may be defined as follows:—

Subfam. *Philoganginae* Kennedy.

Subcostal antenodals more numerous than the costals; basal subcostal antenodals invariably present. Origins of Riv + v and IRiii arising rather distally, about midway between arculus and nodus. Discoidal cell short.

Only one genus—*Philoganga* Selys (Oriental).

Subfam. *Amphipteryginae* n. subfam.

Costal secondary antenodals more numerous than the subcostals, which latter are usually absent between the arculus and nodus. Origins of Riv + v and IRiii very close to arculus; discoidal cell elongate.

Genera are both recent and fossilliferous:—

Recent: *Diphlebia* Selys (Australian), *Amphipteryx* Selys Neotropical, *Devadatta* Kirby (Oriental), *Pentaphlebia* Förster (Ethiopian), and *Pseudolestes* Kirby (Oriental). Fossilliferous: *Dysagrion* Scud. (Eocene), *Protamphipteryx* Cock. (Eocene), *Petrolestes* Cock. (Eocene), *Phenacolestes* Cock. (Miocene).

To these, *Hypolestes* also probably belongs if its larva has been determined correctly, although it must be pointed out that the postnodals are in strict alignment with the cross-veins posterior to themselves and this

alone would place the genus in the *Megapodagriidae*. It will be noticed that Dr. Tillyard has placed the two genera *Dysagrion* Scudd., and *Phenacolestes* Cock., in the *Megapodagriidae*, but in both these, the postnodals fail to coincide with the cross-veins behind them, a character which carries them forward to the *Amphipterygidae*. *Dysagrion, Phenacolestes, Petrolestes, Philoganga* and *Diphlebia* form an instructive series demonstrating the gradual recession of the origins of Riv + v and IRiii.

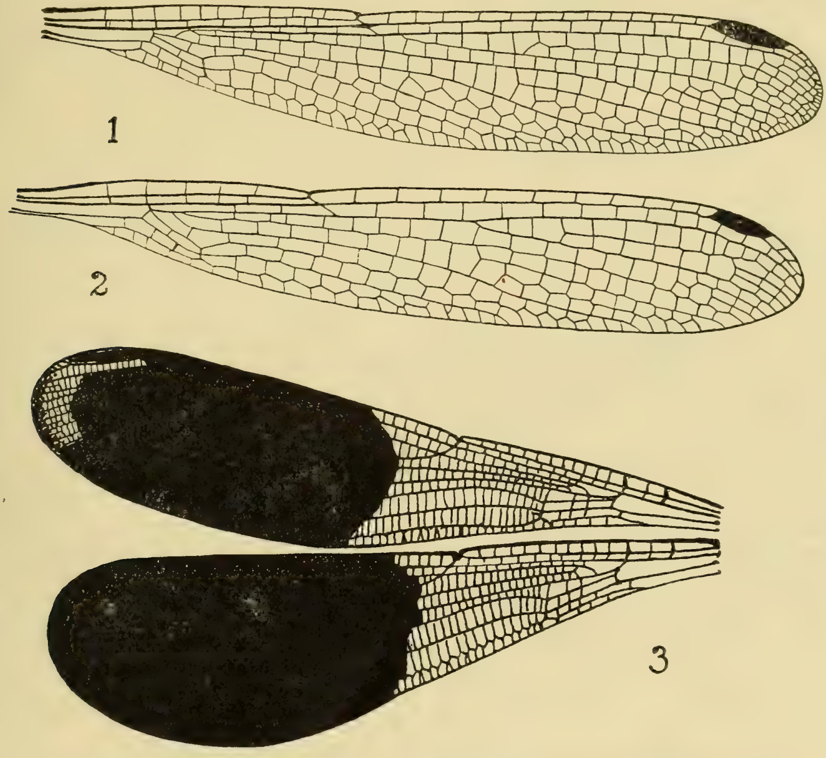


Fig. 5.—Chlorocyphidae:—1.—*Chlorcypha* Fraser (Ethiopian). (Note the anterior arching of Rii + iii). 2.—*Libellago* Selys (Oriental). (Note the absence of the anterior arching of Rii + iii in this primitive genus). 3.—*Rhinocypha tincta* Rambur (Australia). (Rii + iii markedly arched.).

Family 2. CHLOROCYPHIDAE Cowley. (Fig. 5, 1 to 3.)

Wings subpetiolate, narrow and similar in shape in the females, narrow or more or less dilated medially, especially the hindwing, in the males. The primary antenodals always present, as well as numerous secondaries, varying from five to twenty. Nodus situated between one-third and halfway along the costa; discoidal cell an elongate rectangle, always traversed; pterostigma narrow, elongate and strongly chitinized. Rii + iii, shortly after leaving Rs, straight in primitive genera, but distinctly arched

anteriorly in all others; IA zigzagged and with a single row of cells behind it. Head very narrow, eyes very large and placed more closely together than in other Zygoptera; clypeus projecting forwards markedly as a kind of snout. Thorax robust, abdomen shorter than wings (except in the aberrant genus *Rhinoneura* Laidlaw, where the abdomen is slender and longer than the wings).

Larvae differing markedly from those of the previous family; head subtriangular, with rather long antennae and strongly projecting front; labial mask with triangular medial lobe, cleft in the middle, the lateral lobes narrow, armed with setae near the base and furnished distally with hooks and sharp teeth. The legs very long and slender; the two lateral caudal gills narrow, horny, triquetral in section and armed with strong spines; the median gill represented only by a stout conical spine (*appendix dorsalis*). Found clinging to drift-wood or floating weeds and submerged roots in montane streams.

From the entire absence of basal antenodals, the persistence of the two primary antenodals and the complete failure of the secondary antenodals to coincide in their costal and subcostal series, we see that this family is one of the most primitive of the Agrioidea and that its origin was from somewhere within the Amphipterygid complex. The earliest forms in the family were undoubtedly close to *Libellago,* in which the antenodal complex is very simple and the vein Rii + iii shows but little sign of the anterior arching which later characterizes the Agrioidea. *Libellago* is purely Oriental in distribution, so that we may safely surmise that this family had its origin in Asia and spread later eastwards to the Pacific, southwards to Oceania, and westwards to Africa.

Two aberrant genera must be noticed, viz., *Rhinoneura* Laidlaw, and *Disparocypha* Ris. The former is characterized by its strongly petiolated wings and long abdomen, which both suggest an origin from a form approaching *Devadatta,* but the forward arching of Rii + iii rules this out. The other genus, *Disparocypha,* which agrees with *Rhinoneura* in the curious shape of its pterostigma, is characterized by a great reduction of the base of the wings. History has repeated itself in this genus, for just as the anal vein, by reduction of the base of the wing, became confluent with the posterior border in the Coenagrioidea, so in this genus, by a similar process, the anal vein has become fused with the wing border, along which it can be traced to as far as the first cross-vein below the discoidal cell. It is the only genus in the whole of the superfamily Agrioidea in which the anal vein is so confluent. The slight arching of Rii + iii towards Ri shows that the genus postdates *Libellago* and that it probably arose from the same stem and at about the same time as did *Rhinoneura.* It is to be noted that a remarkable resemblance exists between *Disparocypha* and the interesting and puzzling Australian genus *Lestoidea* Tillyard; thus they agree in the position of the arculus, the shape of the discoidal cell, the number of longitudinal veins, including the intercalaries, and lastly, by the fusion of the anal vein with the posterior border of the wing. Were it not for the almost complete absence of genera belonging to this family in Australia, one would be inclined to see in these similarities, a relationship which links up the Chlorocyphidae with the primitive Coenagrioidea.

Only a single genus with a single species is found within Australian limits, viz., *Rhinocypha tincta* Ramb., Queensland and N. Australia. The genera are: *Libellago* Selys, *Rhinoneura* Laid., *Disparocypha* Ris, *Indocypha*

Laid., MS, *Neocypha* Cowley, *Rhinocypha* Ramb., *Chlorocypha* Fras., and *Calocypha* Fras. (*Libellago asiatica* Selys is the genotype of *Neocypha*, and *Libellago asiatica* subspecies *vittata* that of *Indocypha*). All are Oriental save *Chlorocypha* which is Ethiopian.

Family 3. HELIOCHARITIDAE n. fam. (Fig. 6, 1 and 3.)

Wings long and narrow, petiolate nearly to level of arculus or to slightly proximal of the level of the vein Ac. The two primary antenodals present but widely separated by numerous secondary antenodals, which latter are of both series and many coinciding, especially in the hindwing; basal antenodals almost invariably present, these sometimes complete but usually of

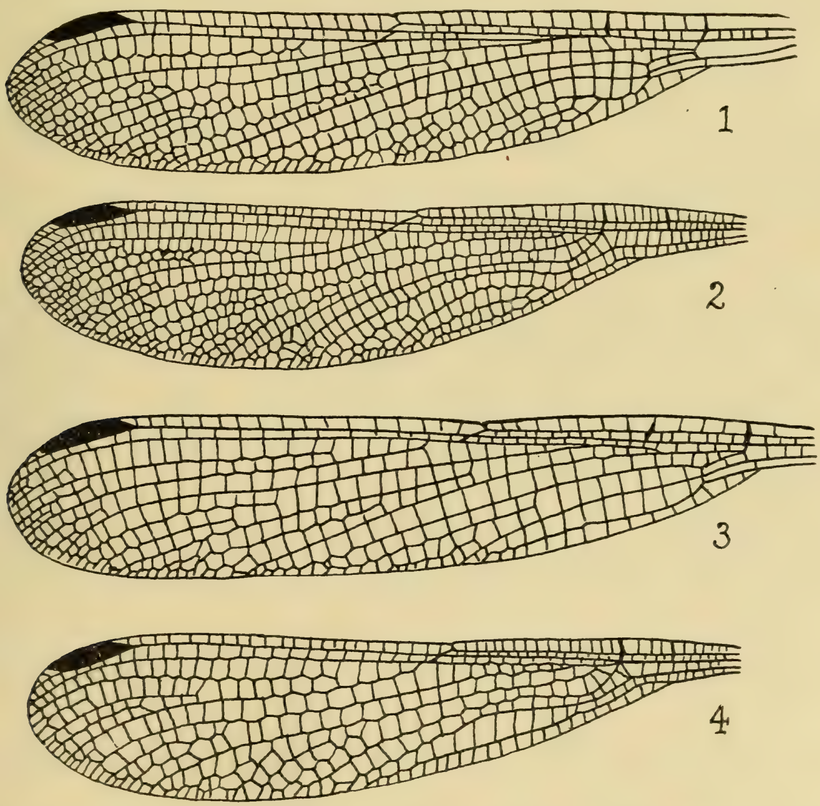


Fig. 6.—Demonstrating the connecting links between the Heliocharitidae and Polythoridae:—1.—*Cyanocharis* Selys.—An advanced type with triadic branching of the anal vein as in the Polythoridae, as shown in—2.—*Cora* Selys. 3.—*Heliocharis* Selys. The anal vein is simple in this genus as in others of the family save *Cyanocharis*. 4.—*Miocora* Calvert.—The most primitive genus of the Polythoridae. Note that it has preserved the simple unbranched condition of the anal vein as in the Heliocharitidae.

the subcostal series only; nodus situated between one-third and half-way along the costa; arculus normal, lying much nearer to base of wing than to nodus and either midway between the primary antenodals or nearest the proximal one; Rs and MA arising normally from about the middle of arculus; Rii + iii arched strongly anteriorly shortly after its origin and thereafter, for a short distance, lying in close contact with or occasionally fused with Ri. Discoidal cell a narrow rectangle, traversed by one or two veinlets; pterostigma elongate, strongly chitinized; IA extending nearly to middle of wing, curving rather abruptly posteriorwards after the level of the discoidal cell, unbranched (except in *Cyanocharis*), area posterior to it undeveloped and narrow; basal space often traversed by several nervures.

This family, which is confined to South America, is evidently derived directly from the Amphipterygidae and from the same stem as *Amphipteryx*, which is the earliest known form to show the basal space traversed, although only occasionally. The family shows an advance on the Amphipterygidae by its shorter petiolation, the greater development of the antenodal complex and the anterior arching of Rii + iii. These characters, the posterior curving of IA and the triadiate branching of the same vein seen in *Cyanocharis*, all serve to bridge the gap between the Amphipterygidae and the Polythoridae.

The genera are:—*Heliocharis* Selys, *Dicterias* Selys, *Charitopteryx* Cowley, and *Cyanocharis* Needham. No fossil species are known.

Family 4. Polythoridae n. fam. (Fig. 6, 2 and 4.)

Wings very variable in shape, petiolate (*Cora, Miocora*) or subpetiolate (*Euthore, Polythore, Chalcopteryx*); both primary antenodals present in *Euthore* and some species of *Cora* (footnote 1) but the proximal one absent in all other genera; secondary antenodals numerous, the two series mainly in alignment, except in *Cora* and *Miocora*; numerous additional basal antenodals present; median space traversed by several veinlets; basal side of discoidal cell produced anteriorly to as far as the Radius, so that the anterior arculus is abolished, and the cell itself is greatly distorted and appears suspended, as it were, from the distal primary antenodal, which latter is compensatingly strengthened and thickened to take the place of the arculus and the pull of the long main veins running from the discoidal cell; Riv + v and IRiii arising close together and close to discoidal cell; both these veins descend from Rii + iii, which continues the lines of Rs and runs almost parallel to the Radius; Rii arising at about the level of the subnodus; IA branching triadically shortly after the level of the discoidal cell, save in *Miocora* where the anal vein is simple as in the Heliocharitidae (but in *Cyanocharis*, IA is triadically branched as in the Polythoridae).

The only known larval form is that of *Cora*, which bears a close resemblance to that of *Euphaea* (Epallagidae); it has saccoid truncated caudal

Footnote 1.—Calvert states that *Miocora* resembles *Cora* in possessing only one primary antenodal (Calvert, 1917, Ent. News, 29: 260), but some species of the latter, viz., *C. modesta* Selys, etc., possess the two, although the proximal one is not nearly as robust as the distal one. It seems evident that he has overlooked the proximal primary in *Miocora* as he has in the case of *Cora;* the venation of the former is so primitive that both primaries must be present. In both genera, the secondaries fail to coincide, a condition which goes with the presence of both primaries. I have not had the opportunity of examining *Miocora* or some of the species of *Cora*.

gills and lateral, so-called, abdominal gills (footnote 2); the labial mask is flat and has two small teeth on the lateral lobes.

This family, as for the last, is confined to the Neotropics, and is undoubtedly a descendant of the Heliocharitidae. The evolutionary connecting links are unmistakeable and are as follows:—

1. The two primary antenodals found in the Heliocharitidae are also present in *Euthore* and some species of *Cora* (*C. modesta* Selys) but the proximal one has become obsolete in the more highly developed genera of the Polythoridae.
2. The anal vein is simple and unbranched in the Heliocharitidae, except in the highest developed genus *Cyanocharis* where it is triadically branched. *Miocora* of the Polythoridae has preserved the simple unbranched condition of the anal vein as in the Heliocharitidae, but all other genera of the Polythoridae have the triadic condition found in *Cyanocharis*.
3. In the Heliocharitidae, the stem of Rii + iii runs anteriorly as an *oblique vein* to nearly meet the Radius; in the Polythoridae, owing to the approximation of the discoidal cell to the Radius, and the thereby abolition of the arculus, *this oblique vein has become straightened out* and comes to lie in continuation with Rs and almost parallel to the Radius; Rii + iii still retains its position close to the Radius, as in the Heliocharitidae, the only difference being that its arch has been flattened out.

The genera are:—*Miocora* Calvert, *Cora* Selys, *Euthore* Selys, *Polythore* Calvert and *Chalcopteryx* Selys (Recent), and *Protophore* Cock. (Eocene).

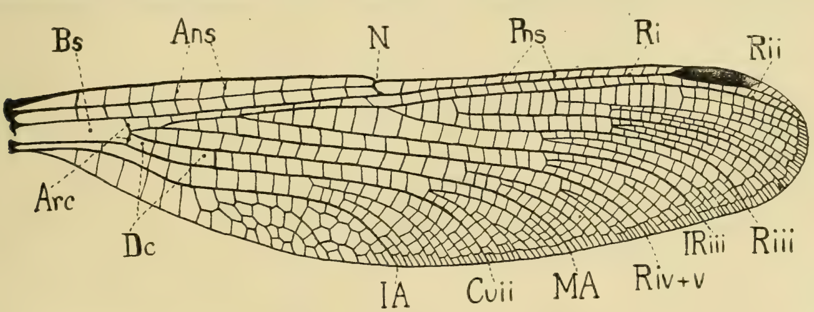


Fig. 7.—*Epallage fatima* Charp., showing the venation of the Epallagidae.

Family 5. Epallagidae n. fam. (Fig. 7.)

(= *Epallaginae* Fraser, 1928.)

Wings either non-petiolate or very slightly petiolate, the petiolation never extending as far distal as the proximal primary antenodal. Antenodals very numerous and *all in strict alignment; primary antenodals both absent.* Basal antenodals numerous and all in alignment (these not

Footnote 2.—The abdominal gills found in certain Zygopterous larvae do not actually function as respiratory organs but are a secondary development and, in fact, pseudopodia, which act as anchoring devices to prevent the larvae being swept away by the swift currents of the streams in which they live.

differentiated from the other antenodals but evidently present as the space between the usual position of the proximal primary antenodal and extreme base of wing, which is normally empty, is completely filled); Nodus near the mid point of costa and situated far out from the arculus; arculus normally present; Rii + iii arching strongly anteriorwards shortly after its origin as in the *Heliocharitidae* but accentuated, this arching bringing Rii + iii either very close to Ri or in actual contact and fusion with it for as far as the origin of IRiii (thus the origin of this vein and Rii + iii appears to be from Ri, while its true origin is indicated by the oblique vein arching up from Riv + v). Discoidal cell rectangular, two to four times as long as wide, entire or traversed by veinlets; pterostigma elongate, strongly chitinized. IA sigmoidally curved; area between it and posterior border of wing filled with several rows of cells distally, these cells separated by more or less complete supplementary veins.

The known larval forms resemble rather closely those of the Amphipterygidae (*Diphlebia* and *Philoganga*), being rather robustly built, with saccoid or triquetral caudal gills and often abdominal gills. The labial mask resembles that of the Amphipterygidae but the distal teeth on the lateral lobe are reduced to two or one. (*Euphaea* has abdominal gills and is found in torrential streams, in which habitats, they serve to anchor the larva to rocks; *Anisopleura* is without these appendages but as they breed in slow water-courses, such as irrigation channels and sluggish streams. the need for them has not arisen.)

This family, which is mainly Oriental in distribution but extends as far westwards as Greece, has no representatives in Australia, nevertheless, its origin was probably in Oceania and from some such Amphipterygid type as *Diphlebia* (Australia). In it we find the antenodal complex reaching its culmination and the whole of the costal and subcostal areas, from base of wing to nodus, are filled with homogeneous synchronized cross-veins. Development of the wing thereafter was confined to broadening it and the adding of numerous intercalated veins and the system of cross-veins and, lastly, to a complicated branching of the anal vein. In the Epallagidae, this development remained almost static in the the case of the females, which have preserved the most primitive type of venation found in the family; thus the females belonging to the different genera are remarkably homogeneous and considerable difficulty is occasionally found in differentiating them. It follows from this, that those genera in which the males most closely resemble the females, are the most primitive. Thus *Epallage* and *Dysphaea ethela*, in which the sexes are undifferentiated save by sexual characters, are the most primitive forms found in the family, and from these we pass to others in which the differentiation becomes ever more wide. Evolution in the males is marked first of all by a tinting of the wings which deepens to a strong amber shade and then becomes infumated and finally opaque; at the same time, there is a gradual broadening of the wings, especially of the hind ones, which are broadened medially and not at the base as in the Anisoptera. The factors bringing about such broad differentiations between the sexes have already been fully discussed above and need not be repeated here.

Genera included in this family are:—*Epallage* Charpentier, *Dysphaea* Selys, *Euphaea* Selys, *Allophaea* Fraser, *Indophaea* Fraser, *Anisophaea* n.nom. (= *Mesophaea* Fraser, preoc.), *Heterophaea* Cowley, *Anisopleura* Selys, *Bayadera* Selys and *Cyclophaea* Ris.

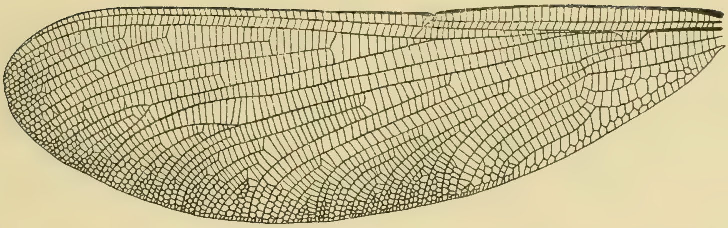


Fig. 8.—*Neurobasis chinensis* L. (Queensland), showing the venation of the Agriidae.

Family 6. AGRIIDAE, Tillyard. (Fig. 8.)

Wings non-petiolate, densely reticulated, including, in some genera, the basal space (but this entire in the majority), more or less broadened, the greatest breadth being near the middle of the wings. Nodus from one-third to half-way along the costa; arculus always normal and situated much nearer base of wing than nodus. Antenodal complex complete as in the *Epallagidae;* Rs and MA arising from arculus at or below its centre, or, in the case of the *Hetaerininae,* from its lower part close to CuP. Rii + iii arched as in the *Epallagidae* and usually fused for a short space with Ri. Discoidal cell either an elongate rectangle, very narrow, simply crossed or densely reticulated, or else an irregular quadrilateral with convex anterior side, as in the *Hetaerininae.* Supplementary veins very numerous, straight or more or less strongly curved. The anal vein, IA, which in all previous families forms part of the posterior border of the wing in its basal portion, is, in this family, for the first time, entirely within the wing, and the whole posterior border a simple vein; distally, after the level of the discoidal cell, IA turns obliquely posteriorwards and is then either strongly curved sigmoidally or more or less complexly branched owing to a linking up of some of the numerous supplementary veins developed posterior to it. Usually many additional cross-veins in the cubital space, so that the anal tracheal crossing, *Atc* (= *Ac* Tillyard) is usually obscured (it is isolated and distinct in *Vestalis amoena*). Pterostigma variable, often reduced or entirely absent, especially in the males (in the females, it is usually in a state of atrophy as evidenced by a number of new or additional postnodal veinlets which traverse it; this is usually alluded to as a "false or pseudo" pterostigma, but it would be more correct to call it an "atrophied" one).

This family is made up of a large number of very heterogeneous forms of medium or large size, with head transverse, eyes wide apart, thorax not very robust, abdomen long and slender, and, in the males, always longer than the wings. The superior appendages are forcipate in type. Brilliant metallic colouring of the wings in the males is often found, and this extends to the body and abdomen in both sexes. The larvae are slender bodied with very long antennae, very long, slender legs, cylindrical, slender abdomen and long narrow caudal gills; the labial mask is also long and slender, with deeply cleft median lobe and narrow lateral lobes armed with sharp distal teeth and a long slender movable hook, beneath which setae may or may not be developed. They breed in fast running streams as a rule, and may be found clinging to submerged roots, etc. It is clear that this type of larva is very different from that of the Epallagidae and it would appear to be a more specialized development of the type found in the Chlorocyphidae. The

origin of the family is probably a very ancient one and from the same Amphipterygid complex which gave rise to the families discussed above; one common character links it to the Chlorocyphidae and Epallagidae, viz., the anterior arching of Rii + iii, but this is absent in the primitive forms of the former, so that we are left with the latter as a possible ancestral line. If the Epallagidae fill this position, then we must explain the broad differentiation between their larvae by the totally different habitats in which they live; we know from other larval forms, that evolution in them has been as great as in the imagines. The culmination of the antenodal complex into a homogeneous unit has been accomplished in the Agriidae as well as in the Epallagidae. Is this a pure coincidence? or has it been called forth by the same mechanical factors? The latter would seem to be the correct solution since we find it again occurring in the case of the Anisopterous Libellulidae, which can have no near relationship with these two families.

The family is cosmopolitan in distribution but only a single form is found in Australia (*Neurobasis chinensis*). It falls naturally into three subfamilies, although I am doubtful as to the relationship of the Hetaerininae. The Agriinae are found throughout Asia, Africa, Europe and North America, whilst the Hetaerininae are confined almost entirely to South America, their only contact with the *Agriinae* being by means of a few species of *Hetaerina* with *Agrion* in North America. This terminal and isolated distribution of *Hetaerina* might suggest, at first sight, a derivation from *Agrion*, but the character of their venation entirely precludes such a possibility. For either to arise from the other would entail a complete remoulding of the basal venation of the wings; it certainly could not have been effected by a simple process of reduction or addition to the venation. Thus there seems good reason to believe that the *Hetaerininae* have had an independent origin and have developed along parallel lines to the *Agriinae*.

Subfamily Hetaerininae n. subfam.

Wings narrow, similarly shaped; discoidal cell strongly curved convexly anteriorwards, its basal side very short; sectors of arculus arising from the lowest part of arculus; basal space always traversed by veins; CuP and IA markedly sigmoidally curved; males with the basal area of wings closely reticulated and coloured with some shade of red and usually with a point of red or black at tips of hind wings; pterostigma usually absent in both sexes.

Genera:—*Hetaerina* Selys, *Mnesareta* Cowley. (Neotropical.)

Subfamily Agriinae n. subfam.

Wings broader than the last, sometimes very broad and variable in shape; discoidal cell a narrow rectangle, with straight anterior side; sectors of arculus arising from middle of arculus; basal space entire or, occasionally traversed; CuP straight; IA variable; males very variable but usually widely different in coloration from the females; pterostigma present or absent, usually present in the females but with veinlets traversing it and markedly atrophied. (Cosmopolitan.)

Genera:—*Agrion* L., *Mnais*, Selys, *Neurobasis* Selys, *Vestalis* Selys, *Matrona* Selys, *Matronoides* Förster, *Echo* Selys, *Climacobasis* Laidlaw, *Psolodesmus* McLachlan, *Archineura* Kirby, *Phaon* Selys, *Sapho* Selys, *Umma* Kirby.

Subfamily CALIPHAEINAE Fraser.

Wings very narrow, similarly shaped, *petiolated* nearly to the level of the anal tracheal crossing; discoidal cell very short, slightly curved anteriorwards, traversed by only one or two veinlets; sectors of arculus arising from just below middle of arculus; basal space entire; CuP and IA straight, the area posterior to the latter totally undeveloped and only one row of cells between it and border of wing; the sexes similar; pterostigma present, a short rhomboid.

Genera:—*Caliphaea* Selys. (Oriental.)

This genus, one of the most puzzling in the Order, is placed in the Agriidae on account of the fusion of Rii + iii with Ri and the completely developed antenodal complex. It appears to be an Agriid which has undergone great reduction of the base of the wings, closely paralleling *Disparocypha* of the *Chlorocyphidae* in this respect. Its larva is unknown but the imago occurs in marshes where it has been seen to oviposit; it is the only species of the Agrioidea, I know of, which breeds in stagnant waters.

Suborder 5. PROTANISOPTERA, Carpenter. (Figs. 9 and 10.)

Odonata with moderately broad, non-petiolate wings, the hind only slightly broader than the fore-wings; precostal area present, from the apex of which runs a very oblique, brace vein to descend through the subcosta to the radius; antenodals numbering from 4 to 15 or more, the primaries absent (doubtfully present in *Polytaxineura* Till., Upper Permian, N.S.W.), secondaries numbering from 1 to 12 or more, mostly non-coinciding; postnodals

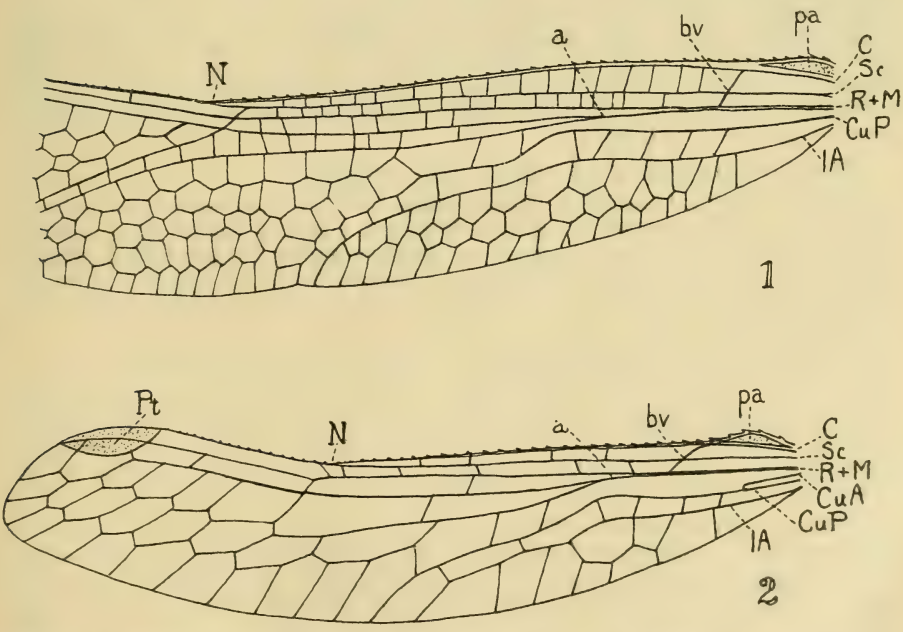


Fig. 9.—1.—*Polytaxineura stanleyi* Till. (Permian of Australia). 2.—*Ditaxineura anomalostigma* Till. (Lower Permian of Kansas).

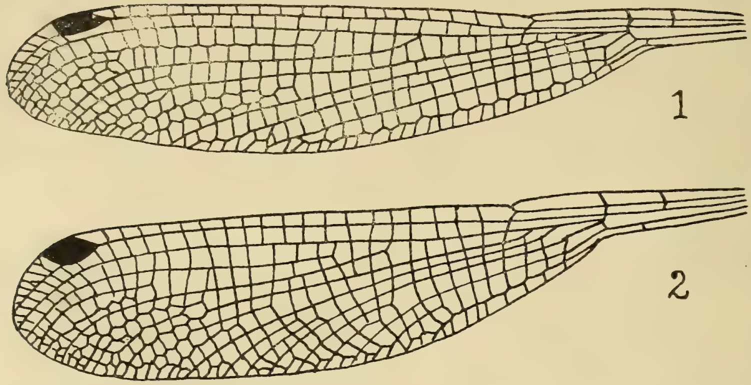


Fig. 10.—Forewing of *Palaeothemis tillyardi* Fraser. In Fig. 2, all the recent additions to the basal and antenodal venation have been removed to show the primitive Zygopterous foundation on which the Anisopterous wing is built. Compare with *Ditaxineura* and *Amphipteryx* (Fig. 4, 3 and 2.).

absent or very few in number; nodus situated distal to the middle of costa, always present and well developed; arculus rudimentary, very oblique; discoidal cell an elongate subquadrangle open at the base in both fore and hind-wings; a rudiment of CuA sometimes present; CuP and IA markedly sinuously curved as in the Meganisoptera, the latter vein always free of the posterior border of wing and arising from its extreme base; anal trachea crossing, Ac, doubtfully present; pterostigma abnormal, bisected by the Radius, broadly fusiform in shape; anal area of wings, posterior to IA made up of 2 to 4 rows of cells.

The Suborder falls naturally into two families:—

Fam. 1. *Ditaxineuridae*.—Basal remnant of CuA present; nodus and subnodus primitive in form; antenodals few, the two series not in alignment except the basal brace vein; postnodals absent; pterostigma broadly fusiform, projecting across radial space nearly to the level of Rii; cross-veins and cells in distal part of wing arranged in two gradate series (as in the *Chrysopa*). (Fig. 10, 2.)

One genus:—*Ditaxineura* Tillyard. (Lower Permian, Kansas.)

Fam. 2. *Polytaxineuridae*.—Basal remnant of CuA absent; nodus and subnodus well developed and in line; antenodals numerous and a few in alignment occasionally; postnodals few or absent; pterostigma unknown; cross-veins and cells in distal part of wing not arranged in a gradate series, usually an irregular network. (Fig. 10, 1.) 9

Genera:—*Polytaxineura* Tillyard (Upper Permian, N.S.W.), *Pholidoptilon* Zalessky and *Permaeschna* Martynov (both of Upper Permian of Russia).

Dr. Tillyard states (Proc. Linn. Soc. N.S.W., 1935, 60:375) that the Ditaxineuridae foreshadow the Libelluloidea, and the Polytaxineuridae the Aeshnoidea (more open venation, shorter pterostigma, fewer antenodals and postnodals), but it must be pointed out that these characters apply equally well to both superfamilies. The Polytaxineuridae, he thinks, lie in

the direct ancestral line of the Anisozygoptera and thereby expresses his whole-hearted belief in Carpenter's theory. This, then, brings us to the most controversial part in the history of the evolution of the Odonata, viz., whether the two major suborders have developed along parallel or serial lines from a common ancestor. This, I think, is best put in the form of the following question:—

"Have the Anisoptera descended from the Protodonata through, or quite independently of, the Zygoptera?"

Whilst there seems to be no doubt that the Anisoptera developed from the Anisozygopterous complex of types, a wide difference of opinion exists among students of the Order as to what was the actual line of descent of the latter. Apart from previous and, now, discarded theories, two hold the field and are best designated by the names of their authors:—

Tillyard's theory.

This theory seeks to explain how the broad base of the Anisopterous wing developed from the narrow, petiolated Zygopterous one by means of recurrent branches thrown off from the stem of the anal vein. Tillyard postulated that the vein IA in both the suborders Anisoptera and Zygoptera was fused at its base with the cubitus, CuP, and that its free condition in the former was only *apparent* and not real. He pointed out that in most primitive forms of Zygoptera, a short vein, which he termed A', could be seen running basalwards from the angle formed by the junction of Ac (*Anal crossing*) and Ab (*Anal bridge*) to the posterior border of the wing. The true course of the anal vein was laid down on its trachea, which could be seen in the larval wing running obliquely up to join CuP and then leaving it by means of Ac, to continue its course along Ab. This was exactly the same reasoning which Comstock and Needham employed to explain the crossing over of Rs, and which Tillyard himself had discredited. The short vein A' was, he said, a recurrent and bridge-like structure designed to connect the anal vein to the broadening base of the wing.

In the Zygoptera, this bridge was necessarily short, but as the base of the wing broadened, the bridge gradually extended proximalwards until it finally arrived at the base of the wing. At first very oblique, it gradually straightened out and finally assumed the same line as the distal part of the anal vein itself, so that it took on the appearance of being part of and the base of that vein. By further branching of this vein, the broad base of the Anisopterous wing has been developed.

Dr. Tillyard also pointed out that the evolution of the hindwing in the Odonata was generally a stage ahead of that of the forewing; arising from this could be explained the Zygopterous nature of the discoidal cell in the forewings of the Anisozygoptera, compared to its Anisopterous nature in the hindwings; thus the Zygoptera were linked up with the Anisoptera.

It will be seen from a perusal of the previous part of this paper, that Dr. Tillyard had abandoned this theory in favour of Carpenter's, but in doing so I feel that he was certainly premature. As I shall try to show, he was quite correct in his original surmise that the Anisoptera had descended from the Zygoptera, although the means, given by him, by which this was accomplished, must be modified in the light of the new evidence now available.

Carpenter's theory:—

This theory seeks to explain that the anal vein in the Anisoptera has

always had an independent origin from the base of the wing, and that its pretracheation is quite as fallacious as Needham's supposed crossing of Rs. The Anisoptera therefore were derived from a type with a broad base to the wings, and in which the anal vein was independent of CuP. Such types he has described from the Permian of Kansas and designated Protanisoptera. The Zygoptera, on the other hand, have the anal vein fused at its base with CuP and are therefore a specialization over the Anisoptera; these, he claims, arose from the Protodonata independently of the Anisoptera and through Protozygopterous types.

Carpenter was undoubtedly correct about the independent origin of the anal vein in the Anisoptera, but, as I shall show, he was quite fallacious in his interpretation of its origin in the Zygoptera. Carpenter in his definition of the Protozygoptera gives: "CuP and IA fused together for the length of the petiole"—(Carpenter, 1931, Amer. J. Sci., 21:115), and again (p. 132, op. cit.): "There can be no doubt, of course, that CuP and IA are fused in *Kennedya* and *Progoneura* (Protozygoptera)", yet in the same work (p. 112) he says:—"I do not believe that either the tracheation of the nymphs or the data of paleontology have proved that Ac is a portion of the true anal vein IA; on the contrary, for reasons discussed below, I consider the tracheal studies to be as negative as those on the radial sector and the media, and regard the paleontological evidence as positive proof against the accepted understanding of the anal crossing". Therefore I feel, that he, in spite of his interpretations of the course of the anal vein in the Zygoptera, had an intuition that such a solution was not altogether correct.

To these two theories I now add a third and, I hope, a correct one. This new theory seeks to prove that the Anisoptera have, in their descent from the Protodonata, passed through a Zygopterous stage, and that proof of this rests on the evidence afforded by a number of vestigial Zygopterous characters found in present-day Anisoptera. Moreover, it shows that the anal vein arises independently of CuP from the base of the wing in the Zygoptera as well as in the Anisoptera.

In stating my theory, I shall employ the evidence to be obtained from a comparative study of the following five structures in the Odonate wing:— 1.—The primary pair of antenodal nervures. 2.—The cubito-anal cross-vein Ac (anal crossing). 3.—The nodus. 4.—The origins of the two main veins Riv + v and IRiii, and, lastly, 5.—The discoidal cell.

1.—The primary antenodal nervures. (Fig. 1.)

In the costo-antenodal area of any wing belonging to the Anisopterous families Petaluridae, Gomphidae, Cordulegasteridae, Aeshnidae and the more primitive forms of the Libellulidae (*Synthemiopsis* and *Synthemis*, Australia), two robust antenodals are found strongly differentiated from the remaining weaker ones. They are always situated at about the same relative distance from the base and nodus of the wing and from each other. The proximal one of these, save in a few cases, where one or more subcostal basal antenodals have been added, is always the most basal of all the antenodals. If these and their relative positions be compared with a similar pair of antenodals present in all the Zygoptera (except in the more highly developed families Epallagidae and Agriidae), it will be seen that they agree so closely as to leave no doubt that they are homologous and obviously derived from a common ancestor. As they are absent in the Protodonata, it follows that they must have been derived from the Protozygoptera or Protanisoptera. In the former (*Progoneura* and *Sushkinia*), a

pair of antenodals is found occupying the same relative positions as the primaries of present-day genera, but the costal and subcostal portions of these are not in alignment. As we ascend the ladder of evolution, however, as in *Kennedya* and all succeeding forms of the Coenagriidae, we find these portions have come into alignment and now form the two robust antenodals which we still see in recent genera.

In the Protanisoptera, the evidence of primaries is not nearly so clear. Both Tillyard and Carpenter have fallen into the same error of confusing an oblique vein running from the apex of the precostal area from costa to radius, as the proximal primary antenodal vein but it is far too near the base of the wing, far too oblique and there exists no evidence that it was formed from separate costal and subcostal portions, for it to be the homologue of this vein. In *Ditaxineura* there exist a number of costal and subcostal antenodals, but they are not nearly in alignment; however, there is a possibility that two strong antenodals could be formed from these by subsequent alignment in more highly developed forms succeeding them. In *Polytaxineura* and *Pholidoptilon* the primaries are again doubtfully present; Tillyard gives the 1st, 5th and 6th as the coinciding antenodals; the first of these is, of course, the precostal brace vein, which must be ruled out, and the other two are adjacent to one another and so close together as to differ entirely from the positions of true primaries. Of *Pholidoptilon*, Tillyard has said:—"1st antenodal very oblique and complete, and suggests the brace vein of the Plectoptera". This again is the precostal brace vein and, apart from it, there is only one other coinciding, which occupies the position normally occupied by the distal primary antenodal.

Thus from the poor evidence of primary antenodals in the Protanisoptera and the undoubted evidence of these in the Protozygoptera, as well as the appearance of these vestigial structures in the wings throughout the Anisoptera, the assumption must be that the latter suborder has developed from Zygopterous ancestors.

2.—The cubito-anal cross-vein (anal crossing, Ac). (Part I, *Ac* in all figures.)

In the cubital space throughout the whole Order Odonata, a short cross-vein is found connecting CuP with the posterior border of the wing, or with the anal vein where this intervenes. It is especially plain in the Coenagrioidae and the Anisoptera, because in them there are no other cross-veins in this space with which to confuse it. (In a small percentage of the Anisoptera, other cross-veins may be present, but as the cubito-anal vein is nearly always the most basal, is nearly always very oblique as compared to the other cross-veins, and also, is usually more robustly built, there is never any difficulty in picking it out.) In the higher forms of the Zygoptera, where many cross-veins often occur in the cubital space, difficulty may be experienced in deciding which is the correct vein, but that it is present, can be proved by comparison with other nearly related species; in genus *Vestalis*, for instance, *V. amoena* is the only species in which the cross-veins in the cubital space are restricted and in which the true cubito-anal cross-vein is isolated; it is difficult to pick out this vein in all other species of *Vestalis*. *There is not the slightest doubt that this vein in the two suborders Zygoptera and Anisoptera is homologous and derived from the same source.* The problem is, how far back have we to look for this latter?; did the vein develop from the Protozygoptera or from the Protanisoptera, or did it antedate both of these?

In the Protodonata (*Protagrion*) the space between the veins CuP and IA is traversed by a great number of undifferentiated cross-veins and there is therefore no evidence of the anal-crossing, Ac.

In the Protozygoptera, this space is traversed by a single vein which is very long and very oblique. However, by an examination of all the known forms, we are able to see its evolution into a shorter and less oblique structure which is undoubtedly homologous to the cubito-anal cross vein Ac. We thus see that the anal-crossing was already established in the lower Permian and in the Protozygoptera.

In the Meganisoptera, Lameere pointed out the presence of an oblique vein running between CuP and IA at the base of the wing, which he believed to be homologous to the anal-crossing of the Odonata. Carpenter has since pointed out that this vein is sometimes duplicated and at other times altogether absent, as in *Oligotypus,* so that it cannot be homologous to the vein Ac. I do not think that this point is of much importance to the present problem, since, although the Meganisoptera have descended from the same ancestral Protodonates, they are not necessarily in the direct line of descent of present-day Odonata, that is to say, the Meganisoptera may have branched off from the Protodonata before any reduction of the base of the wing set in, such as we see in the Protozygoptera.

In the Protanisoptera, cross-veins in the cubital space number from 2 to 5, and most of these are more or less oblique and undifferentiated. One of them, however, stands out rather noticeably from its constant position at or just proximal to the pronounced curve in CuP and IA. It is identical in all known specimens of the Protanisoptera and I am therefore of opinion that it represents the cubital vein Ac. Carpenter points out another cross-vein situated near the base of the wing, but, because it is not constant in its presence, rejects it as homologous to Ac; in any case, it is far too near the base of the wing to be this vein. He is of the further opinion that there is no vein oblique enough or sufficiently differentiated to represent Ac and therefore believes that the anal-crossing is altogether absent in the Protanisoptera. But he has overlooked the fact that Ac is constantly present in all recent species of Anisoptera, so that if it is not an ordinal character in the Protanisoptera, these cannot possibly be the ancestors of the Anisoptera. Thus the very character which he raises to invalidate the Protozygoptera as the ancestors of the Anisoptera, turns out to be their best advocate. This will be better understood if the true function of Ac be fully realized. This I have explained in a recently published paper dealing with the fallaciousness of the theory of pretracheation (1938, Proc. Roy. Ent. Soc. Lond. 13: 60-70) and which may be briefly reviewed here:

Veins situated on the periphery of the larval odonate wing have no or but poor tracheal supplies, as evidenced by the atrophied condition of the costal trachea and the total absence of tracheation of the base of the anal vein in the primitive Zygoptera. These peripheral veins receive their nourishment from plasma circulating in the wing-case itself.

The anal trachea arises at the same level as its vein, so evidently, at one time, supplied the base of the vein. It would appear that through reduction of the base of the wing, the anal vein was finally brought on to the wing border with which it fused. In such a position it became a peripheral structure and so was rendered independent of its tracheal supply. It might be thought that, in such a position, the anal trachea would have undergone atrophy, as in the case of the costal one, but there is this great

difference between the two veins, for whereas the costa always remains a peripheral structure, and so always remains independent of a tracheal supply, the anal vein, after a short distance, again enters the body of the wing and from then onwards becomes dependent on some trachea for its nourishment. It is just at the point where it enters the body of the wing that the anal trachea abandons the cubitus and turns back to rejoin its own vein; a fine example of the conservatism of Nature! The anal trachea on leaving its vein at the extreme base of the wing runs forward to join CuP and leaves that trachea to rejoin IA by means of the cubito-anal vein. It is because the anal trachea has always employed this cross-vein that Ac has become *fixed* and still exists as an ordinal character. Thus *the presence of this vein Ac in any wing implies that the ancestral type has gone through a stage where the base of the wing was sufficiently reduced as to bring the anal vein on to the border and drive the anal trachea inwards to the cubitus.* Its constant presence in the wings of the Anisozygoptera and Anisoptera is sufficient proof that their ancestral type was one in which the wings were much reduced, as in the Zygoptera.

3.—The Nodus. (Fig. 11, 1 to 4.)

We are so accustomed to regard the nodus as a pseudo-joint or as a simple and useful landmark in the costa, that we have come to regard it as a homogeneous organ, varying but little or not at all in the various families of the Odonata. In its primitive condition, when it is in the making, it certainly shows wider differentiation, but, from the Coenagriidae onwards, it has not been regarded as an organ which shows any variation. Recently I have made an examination of the nodus throughout the various families, and now show the various types which are present. The chief value in this research, as applied to the present paper, is to show that the nodus in the Protanisoptera is almost identical to that found in the primitive Zygoptera, so that both these suborders might have derived their nodus from the same ancestral type, viz., from the Protozygoptera. Carpenter thinks that the nodus in the Protanisoptera is much more highly developed than that of the Protozygoptera, but this is to be expected, if the former have arisen from the latter. It may be argued that, as they are both found occupying the same geological horizon, one cannot have developed from the other, but it must be pointed out that the Coenagrioidea have shown remarkably little change from Permian times to the present day, so that there is good reason to believe that they went far back of the Permian; evolution, on the other hand, may have been much accelerated in the case of the Protanisoptera.

In his ancestral type for the Anisozygoptera, Carpenter requires that the nodus should be situated at about the middle of the wing or somewhat more distally. But in many of the higher forms of the Zygoptera (*Epallage*) the nodus is at or near the middle of the wing, and we know that such forms developed from those in which the nodus was situated very proximal. Thus I think that the Anisozygoptera could just as easily have developed from some Zygopterous type.

4.—The origins of Riv + v and IRiii.

In the Protanisoptera the origins of Riv + v and IRiii are at the level of the nodus and distal to it respectively. No intermediate forms are known, either fossil or recent, between them and the Anisozygoptera, and, in the latter, the origins of these two main veins have recessed to about midway between the nodus and arculus.

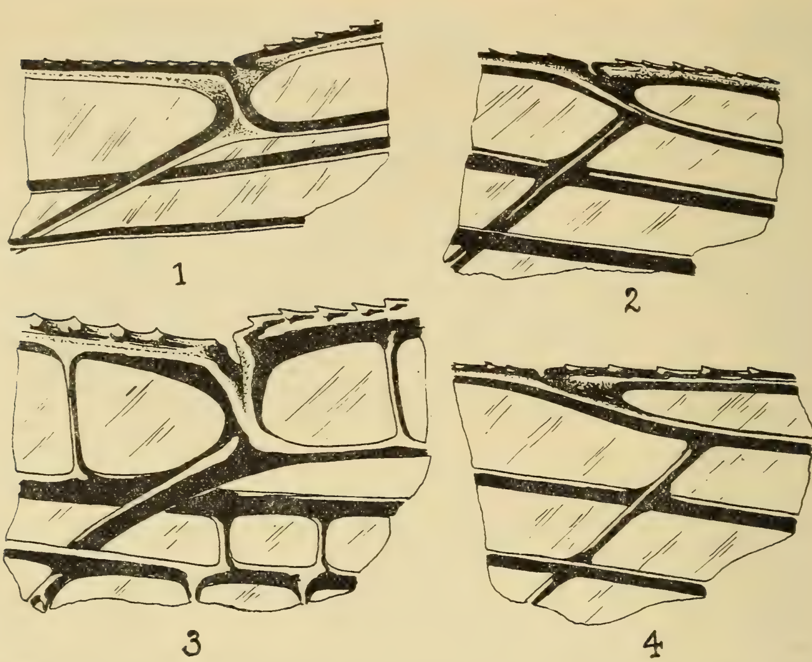


Fig. 11.—The Nodus.—1.—Chlorocyphidae. 2.—Coenagriidae. 3.—Epallagidae. 4.—Protanisoptera. Note the similarity between Figs. 2 and 4, pointing to a common origin for these two suborders.

In the Protozygoptera, the origins of the two veins both lie somewhat distal to the level of the nodus, but as we follow the evolution of their undoubted descendants in the Zygoptera, we are able to follow the recession of these veins step by step until we arrive at a stage quite similar to that found in the Anisozygoptera. *The proximal origin of Riv + and IRiii is basic for the whole of the Anisoptera, as well as for the higher and many lower forms of the Zygoptera,* but we have no evidence that it was so for the Protanisoptera or their earlier descendants, if any.

5.—The Discoidal cell. (Part I, *dc* in all figures.)

The discoidal cell, as a quadrangular space, open at the base, is similar in the Protozygoptera and Protanisoptera. In the former, however, we find it becoming acutely pointed distally in at least one species (*Permolestes gracilis* Martyn.), and it is so for the greater part of the primitive Zygoptera right up to the Megapodagriidae.

In the Anisozygoptera, the discoidal cell of the forewing is of this same character, but that of the hindwing is a stage in advance and has taken on Anisopterous characters, that is to say, although originally typically Zygopterous in shape, it has evolved into one similar to that found in the Anisoptera. There is no evidence to show that the Protanisoptera developed a Zygopterous discoidal cell from which the Anisozygopterous, dimorphic one, could have developed; on the other hand, that for the Protozygoptera could not be more convincing.

It will be seen that the total evidence is overwhelmingly in favour of the Protozygoptera being the true ancestors of the Anisozygoptera and so, of the Anisoptera. Discarding all other evidence save that of the cubito-anal vein Ac, the presence of this in the wings of all Anisoptera is quite meaningless unless we presume for them an ancestor with an extremely reduced and petiolate wing.

In the third and final Part of this paper I shall deal with the Sub-orders Anisozygoptera and Anisoptera.

(To be continued.)

ADDENDA ET CORRIGENDA TO PART I.

126, line 25.—After "Part", insert a comma.

128, line 2.—For "another" read "anterior".

130, line 6.—For "wide-" read "wing-".
line 19.—For "(AP)" read "(AxP)".

133, legend to Fig. 5.—for "schucheri" read "schucherti".

132, line 3 in footnote.—For "agle" read "angle".

134, line 21.—For "On" read "In".

141, line 19.—For "*Palaeothemis* Mart." read "*Permothemis* Mart." The name *Palaeothemis* is preoccupied by *Palaeothemis tillyardi* Fras., in Anisoptera, and the new name was therefore proposed by Martynov, 1935. We greatly regret to report the recent death of this great Russian palaeontologist who was a close collaborator with Dr. Tillyard.
line 8 from bottom of page.—For "Oodonatoid" read "Odonatoid".

142, line 4.—"*Palaeothemis*" correct as for above.
line 22.—For "CuP" substitute "posterior border of wing".

144, line 17.—For "CuP" read "IA" and for "IA" read "the posterior border of wing".
line 24.—For "IA" read "Ac".

148, line 18.—For "Archizygoptera" read "Lestoidea".

149, line 7 of footnote.—For "nervure IA" read "anal trachea".

152, line 11 from bottom of page.—After "or" insert "IA".

163, line 3 of second paragraph.—After "antenodals" insert "except in *Isosticta*".

165, line 15 from bottom of page.—For "subcoidal" read "subdiscoidal".

166, line 3.—For "Onychoargia" read "Onychargia".

167, line 4 in explanation of text-figures.—For "Se" read "Sc".
line 16.—Delete "for"

168, line 8.—For "Avi" read "Axi".

ICHTHYOLOGICAL GENOTYPES: DESMAREST'S DESIGNATIONS, 1874.

By GILBERT WHITLEY.

(By Permission of the Trustees of The Australian Museum, Sydney.)

In continuation of my taxonomic studies on the types of fish genera which appeared in Volume VIII of The Australian Zoologist (1935, p. 136, and 1936, p. 189), I now offer a list of genotypes which I compiled in the Zoological Department Library of the British Museum (Natural History) from a work on fishes by Eugène Desmarest, which is not available here in Sydney.

The work is entitled "Encylopédie d'Histoire Naturelle . . . d'après . . . Buffon, Daubenton, Lacépède, Cuvier", etc., etc. . . . par le Dr. Chenu. The part which is of present interest is the "Reptiles et Poissons avec la collaboration de M. *E. Desmarest*", published in Paris in 1874. This book is "Chenu, 1874.1" of Dean's "Bibliography of Fishes". The preface is dated 15 October, 1856, and the fishes commence on page 183. At the end of the volume is an alphabetical index (Paris, 1880) in which *Coregonus* is spelt *Corregonus* (p. 45) and *Engraulis* is called *Encraudis* (p. 47).

More than one hundred genotypes of fishes are designated by Desmarest and my list of them hereunder includes tautotypes.

I have added authorities, comments, and dates in parentheses ( ).

In compiling this list, I have found Sherborn's "Index Animalium" of the greatest assistance. Fowler is about the only ichthyologist who has made consistent use of Desmarest's genotypes, but with this list available it is hoped that his example will be followed by others. Desmarest's types of *Acanthurus* and *Polynemus*, particularly, are of importance.

My thanks are tendered to the Director of the British Museum (Natural History), Dr. C. Tate Regan, F.R.S., and to members of his staff for their help and courtesy.

DESMAREST'S Page. — GENUS. — GENOTYPE SELECTED BY DESMAREST.

202.—*Perca* (Linné, 1758).—Type, "Perche commune" (*Perca fluviatilis* Linné, 1758).

203.—*Lates* Cuvier, 1829 (= Cuvier & Valenciennes, 1828).—Types, sont *Perca nicolica* (sic) and *minima* Sonnini (= *Perca nilotica* Linné, 1758, and Sonnini's non-binomial species, not *Perca minima* Haldemann, 1842).

203.—*Labrax* (Cuvier & Val., 1828, *non* Pallas, 1810).—*Perca labrax* Linné (1758).

206.—*Rypticus* C.V. (1829).—*Anthias saponaceus* Bloch (& Schneider, 1801).

206.—*Pomotis* (Cuv. & Val., 1829 = Rafinesque, 1819).—*Labrus auritus* Linné (1758).

207.—*Holocentrum* (auctt = *Holocenthrus* Scopoli, 1777).—*Holocentrum longipinne* Cuv. & Val. (1829; but the type should be *Holocentrus sogo* Bloch, 1790—G.P.W.).

207-8.—*Trachinus* (Linné, 1758).—*Trachinus draco* Linné (1758).

209.—*Polynemus* (Linné, 1758).—*Polynemus paradiseus* Linné (1758).

209.—*Paralepis* Cuv. (= Bosc, 1818).—"Paralepis coregonide" (= *Paralepis coregonoides* Risso, 1820).

Desmarest's Page.	Genus.	Genotype Selected by Desmarest.

210.—*Upeneus* Cuv. & Val. (1829).—*Mullus vittatus* Forskal (= Bonnaterre, 1788).
213.—*Cottus* Linné, 1739 (= 1758).—*Cottus scorpius* Linné (1758).
214.—"Platycéphale" (= *Platycephalus* Bloch, 1795).—"P. insidiateur", Bloch (= *Cottus insidiator* Bonnaterre, 1788).
214.—*Scorpaena* (Linné, 1758).—Types, *S. scropha* (= *scrofa*) Linné and *S. porcus* Linné (both 1758).
215.—Ptérois Cuv. (= *Pterois* Schinz, 1822).—*Scorpaena volitans* Gmelin (*i.e.*, Bloch, 1787 = *Gasterosteus volitans* Linné, 1758).
215.—*Pelor* Cuv. & Val. (1829, *non* Bonelli, 1813).—*P. filamentosum*, Cuv. & Val. (1829).
215.—*Synanceia* Bl. (= *Synanceja* Bloch & Schneider, 1801).—*Synanceia horrida* Bl. (= *Scorpaena horrida* Linné, 1766).
216.—"Hoplostèthes" Cuv. & Val. (= *Hoplostethus* Cuv. & Val., 1829).—"H. de la Méditerranée" (= *Hoplostethus mediterraneus* Cuv. & Val., 1829).
220.—*Eques* Bloch (1793).—*E. punctatus* Bloch (& Schneider, 1801).
221.—"Ancylodons" Cuv. (= *Ancylodon* Cuvier and Cloquet, 1816, *non* Illiger, 1811).—*Lonchurus ancylodon* Bloch (& Schneider, 1801) (*A. jaculidens* Cuvier [& Val., 1830]).
221.—*Umbrina* Cuv. & Val. (= Cuvier, 1816).—*Sciaena cirrhosa* Linné (= *S. cirrosa* Linné, 1758).
223.—"Les Etroples" (= *Etroplus* Cuv. & Val., 1830).—*Chaetodon saratensis* Bloch (= *C. suratensis* Bloch, 1790).
224.—*Sargus* (Cuvier, 1816).—*Sargus rondeletii* Cuv. & Val. (1830).
225.—*Charax* Risso (1826).—*Sarus* (= *Sparus*) *puntazzo* Gmelin (1789).
225.—*Chrysophrys* Cuv. & Val (1830, *non* Quoy & Gaimard, 1824, s. str.).—Types, *Sparus aurata* Linné (1758) and *gibbiceps* Cuv. & Val. (1830).
225.—*Pagellus* Cuv. & Val. (1830).—*Sparus erythrinus* Linné (1758).
226.—*Cantharus* Cuv. & Val. (= Cuvier, 1816; preocc. by Bolten, 1798, in molluscs).—*Sparus cantharus* Linné (1758).
226.—*Boops* Cuv. & Val. (= Cuvier, 1816).—Types, *Sparus boops* Linné (1758) and *S. salpa* Linné (1758).
227.—*Smaris* Cuv. & Val. (= Cuvier, 1814; preocc. by Latreille, 1796, in Arachnida).—*Sparus smaris* Linné (1758).
230.—"Les Holacanthes" (= *Holacanthus* Lacépède, 1802).—*Chaetodon tricolor* Bloch (1795).
234.—"Macropode" (= *Macropodus* Lacépède, 1802).—*Macropodus venustus* Cuv. & Val. (1831).
235.—*Ophicephalus* Bloch (1793).—*O. striatus* Bloch (1793).
236.—*Scomber* Linné (1758).—*S. scombrus* Linné (1758).
241.—*Naucrates* Rafinesque (1810).—*Scomber ductor* Linné (1762 = *Gasterosteus ductor* Linné 1758).
242.—*Trachurus* Cuv. & Val. (1833 = Rafinesque, 1810).—*Caranx trachurus* Lacépède (1802 = *Scomber trachurus* Linné, 1758).
242.—"Carouges" Cuv. & Val. (= *Caranx* Lacépède, 1802).—*Scomber carougus* (= *carangus*) Bloch (1793).
242.—*Blepharis* (Cuvier, 1816).—*Blepharis sutur* (= *sutor*) Cuv. & Val. (1833 = *Zeus sutor* Cuvier, 1829).
244.—"Centrolophes" (= *Centrolophus*) Lacépède (1802).—*Coryphaena pompilus* Linné (1758).
244.—"Ptéraclis" (= *Pteraclis*) Gronow (1772).—*Coryphaena velifera* Pallas (1770).

Desmarest's Page.	Genus.	Genotype Selected by Desmarest.

244.—"Stromatées" (= *Stromateus* Linné, 1758).—*S. fiatola* Linné (1758).

245.—*Zeus* (Linné, 1758).—*Zeus faber* (Linné, 1758).

246.—*Amphacanthus* (Bloch & Schneider, 1801).—*A. javus* (Linné) (= *Teuthis javus* Linné, 1766).

246.—*Acanthurus* (Forskal, 1775, non-binom. = Scopoli, 1777, append. p. 505).—*A. hepatus* (Linné) (= *Teuthis hepatus* Linné, 1766).

247.—"*Acanthurus*" Lacépède (i.e., Forskal, 1775, non-binom. = Scopoli, 1777) = *Harpurus* Forskal (should be Forster, 1778).—*A. chirurgus* Bloch (= *Chaetodon chirurgus* Bloch, 1787).

247.—*Naseus* Commerson (= *Naso* Lacépède *ex Naseus* Commerson, MS.).—*Naseus brevirostris* Cuv. & Val. (= Cuvier, 1829).

252.—*Mugil* (Linné, 1758).—*Mugil cephalus* (Linné, 1758).

256.—*Anarrhichus* (= *Anarchichas* Linnè, 1758).—*A. lupus* (Linné, 1758).

258.—*Taenioides* (Lacépède, 1800).—"T. Hermannien" (= *Taenioides hermannii* Lacépède, 1800).

259.—"Dormeurs" (apparently *Eleotris* Gronow, 1763, non-binom..= Scopoli, 1777, is meant—G.P.W.).—Types, *Eleotris gyrinus* Val. (= Cuv. & Val., 1837) and *nigra* Quoy & Gaimard (1824). (But tautotype of *Eleotris* is *E. eleotris* Meuschen, 1778—G.P.W.).

259.—"Philypnes" (= *Philypnus* Cuv. & Val., 1837).—*Eleotris dormitatrix* Cuv. (1829 = *Platycephalus dormitator* Bloch & Schneider, 1801).

264.—"*Malte*" Cuv. (= *Malthe* Cuvier, 1816).—"le Malthée vespertilion" (*Malthe vespertilio* Cuv., 1816 = *Lophius vespertilio* Linné, 1758).

264.—*Batrachus* Bloch & Schneider (1801).—"*B. grannicus* Bloch" (= *grunnicus* Minding, 1832).

266.—"Les Cossyphes, Valenciennes" (= *Cossyphus* Cuv. & Val., 1839, *non* Dumont, 1823).—*Cossyphus muldat* Val. (= *maldat* Cuv. & Val., 1839).

267.—"Crénilabres, Cuv., ou Lutjan Bloch" (= *Crenilabrus* Cloquet, 1818, or *Lutjanus* Bloch, 1790).—*Labrus pavo* Brunnich (1768, *non* Linné, 1758, *fide* Cuv. & Val., Hist. Nat. Poiss., xiii., 1839, p. 149).

268.—*Julius,* Cuv. (= *Julis* Cuvier, 1814 = *Julius* Lafont, 1871; not *Julus* Linné, 1758, a Myriapod).—*Labrus julius* Linné = *Julius vulgaris* Cuv. & Val. (= *Labrus julis* Linné, 1758, and *Julis vulgaris* Cloquet, 1820).

268.—*Xyrichthys* Cuv. (= *Xyrichtys* Cuv., 1815).—*Coryphaena novacula* Linné (1758) = *Xyrichthys cultratus* Val. (= Cuv. & Val., 1839).

272.—*Fistularia* (Linné, 1758).—*F. tabacaria* Bloch (= Linné, 1758).

276.—*Silurus* (Linné, 1758).—*Silurus glanis* Linné (1758).

277.—"les Schibbés (*sic*)" (= *Schilbe* Bosc, 1819).—*Silurus mystus* Linné (1758).

277.—"les Bagres" (= *Bagrus* Bosc, 1816).—Types, "*Silurus bayad* Forsk., Gmel." (= *bajad* Bonnaterre, 1788 = *Bagrus bayad* Cuv. & Val., 1839), and *Bagrus nigrita* Val. (= Cuv. & Val., 1839).

278.—"Platystomes" Agassiz (= *Platystoma* Spix, 1829, *non* Meigen, 1803, diptera).—*Platystoma vaillantii* Val. (Cuv. & Val., 1840).

278.—*Arius* Val. (= Cuv. & Val., 1840).—*Pimelodes rita* Buchanan (= *Pimelodus rita* Hamilton, 1822).

279.—*Synodontis* (Cuvier, 1816).—*Pimelodus synodontis* Etienne Geoffroy [= *P. synodontes* Isid Geoff., 1827] = *Synodontis macrodon* Isidore Geoffroy (1827) = *Silurus clarias* Hasselquist (= Linné, 1758).

280.—*Doras* (Lacépède, 1803).—*Doras castatus* Lac. (*D. costatus* Lacépède, 1803 = *Silurus costatus* Linné).

Desmarest's Page.	Genus.	Genotype Selected by Desmarest.

280.—*Callicthys* (= *Callichthys* Gronow, 1763).—*Silurus callicthys* (= *callichthys* Linné, 1758).
280.—"Héterobranches" d'Et.-Geoff. (= *Heterobranchus* I. Geoff., 1827).—*Heterobranchus bidorsalis* Etienne Geoffroy (= I. Geoffroy, 1827).
282.—*Aspredo* (= Cuvier, 1816 = Scopoli, 1777).—*Silurus aspredo* Linné (1758).
283.—*Loricaria* Lacépède (= Linné, 1758).—*Loricaria cataphracta* Linné (1758).
283.—"Hypostomes" Lac. (= *Hypostomus* Lacépède, 1803).—*Loricaria plecostomus* Linné (1766).
287.—*Cyprinus* Linné (1758).—*Cyprinus carpio* Linné (1758).
292.—"les Tanches" (= *Tinca* Geoffroy, 1767).—*Cyprinus tinca* Linné (1758).
293.—*Rhodeus* Agassiz (1832).—*Cyprinus amarus* Bloch (1782).
293.—"Chondrostomes" Ag. (= *Chondrostoma* Agassiz, 1836).—*Cyprinus nasus* Linné (1758).
293.—*Scardinus* (= *Scardinius*) Ch. Bonaparte (1840).—*Cyprinus erythrophthalmus* Bloch (= Linné, 1758).
295.—"les Catostomes Lesueur" (= *Catostomus* Lesueur, 1817).—*Catostomus communis* Lesueur (1817).
295.—"Sclérognathe Val." (= *Sclerognathus* Cuv. & Val., 1844).—*Catostomus cyprinus* (Lesueur, 1817).
295.—"Exoglosses" Rafinesque (= *Exoglossum* Rafinesque, 1818).—*Cyprinus maxillingua* Lesueur (1817) = *Exoglossum lesueurianum* Rafinesque (1818).
296.—*Anableps* Bloch (= Scopoli, 1777).—*Anableps gronovii* Val. (= Cuv. & Val., 1846) = *Cobitis anableps* Linné (1758).
297.—*Lebias* Cuv. (1816, vernac. = *Lesbias* Bosc*, 1817).—*Lebias calaritana* Bonelli (= *Cyprinodon calaritanus* Cuv. & Val., 1846, *ex* Bonelli MS.).
299.—*Galaxias* Cuvier (1816).—*Esox truttaceus* (Cuvier, 1816).
300.—"Scombrésoces" Lacépède (= *Scomberesox* Lacépède, 1803).—*Esox saurus* Bloch (& Schneider, 1801).
302.—*Clupea* Val. (= Linné, 1758).—*Clupea harengus* Linné (1758).
306.—*Alausa* Cuvier (& Val., 1847 = *Alosa* Cuv., 1829).—*Clupea alausa* Linné (= *alosa* Linné, 1758) = *Alausa vulgaris* Val. (= Cuv. & Val., 1847).
309.—*Elops* Linné (1766).—*Elops saurus* Linné (1766).
309.—"le Butirin Comm. ou Albula Gron" (= *Albula* Scopoli, 1777).—*Clupea macrocephala* Lacépède (1803).
311.—*Lepisosteus* Lacépède (1803).—*Esox osseus* Linné (1758).
312.—*Salmo* Linné (1758).—*Salmo salar* Linné (1758) = *S. salmo* Val. (= Cuv. & Val., 1848).
315.—*Argentina* Linné (1758).—*Argentina sphyraena* Linné (1758) = *A. cuvierii* Val. (= *A. cuvieri* Cuv. & Val., 1848).
315.—*Thymallus* Cuvier (1829).—*Salmo thymallus* Linné (1758).
316.—*"Paradon* Val." (= *Parodon* Cuv. & Val., 1849).—*P. suborbitale* (Cuv. & Val., 1849).
316.—"Citharines" Cuvier (*Citharinus* Cuv., 1816) ou Distichodus Muller

---

*Bosc., Nouv. Dict. Hist. Nat., ed. 2, xvii., 1817, p. 498, is earliest latinization of "Lebias" I have been able to find.

Desmarest's Page.	Genus.	Genotype Selected by Desmarest.

(& Troschel, 1844).—"C. de Geoffroy" Cuvier (*Citharinus geoffroei* Cuv. & Val., 1849 = *Serrasalmus citharinus* Geoffroy, 1809).

316.—"Mylètes" Cuvier (*Myletes* Cuv., 1815).—*Myletes paco* Humboldt (1821).

320.—"les Merluches" (*Merluccius* Rafinesque, 1810).—*G*(*adus*) *merluccius* Linné (1758).

321.—"les Motelles" Cuvier (*Motella* Cuv., 1829).—Types, *G*(*adus*) *mustela* (Linné, 1758) et *G. tricirrhatus* Linné (= Brunnich, 1768).

324.—"les Achires, Lacépède" (*Achirus* Lacépède, 1802).—"A. marbré" (*Achirus marmoratus* Lacépède, 1802).

324.—"les Plagusies" Brown (*Plagusia* Browne, 1789, non-binom. = *Plagusia* Jarocki, 1822, *non* Latreille, 1804).—*Pleuronectes bilineatus* Bloch (1787).

325.—*Cyclopterus* Linné (1758).—*Cyclopterus lumpus* Linné (1758).

329.—*Conger* (Fleming, 1822).—*Muraena conger* Linné (1758).

330.—"les Sphagebranches" (= *Sphagebranchus* Bloch, 1795).—"S. a bec de la Mediterranée" (= *S. rostratus* Bloch, 1795).

335.—*Hippocampus* (Rafinesque, 1810).—*H. guttulatus* Cuvier (1829. Designation invalid as Rafinesque mentions *Syngnathus hippocampus*, 1758, which is tautotype.—G.P.W.).

335.—*Pegasus* (Linné, 1758).—*Pegasus draco* Linné (= *draconis* Linné, 1766, spelt *Pegassus draco* by Swainson, 1839).

337.—*Tetraodon* (Linné, 1758).—*Tetraodon lineatus* Linné (1758); *T. physa* Et.-Geoff. (1809).

341.—*Ostracion* (Linné, 1758).—Types, *Ostracion trigonus* Bloch (= Linné, 1758) and *O. auritus* Cuvier (= Shaw, 1798).

343.—(See 16 lines from bottom of page). *Acipenser* (Linné, 1758).—*A. sturio* Linné (1758).

349.—*Mustellus* Cuv. (= Fischer, 1813, or *Mustelus* Linck, 1790).—*S*(*qualus*) *mustellus* Linné (= *Squalus mustelus* Linné, 1758).

349.—*Selache* (Cuvier, 1816).—*Squalus maximus* (Linné, 1766).

350.—*Centrina* Cuv. (1816).—*Squalus centrina* Linné (1758).

350.—*Zygaena* Cuv. (1816, *non* Fabricius, 1775); *Sphyrna* Raf. (1810).—*Squalus zygaena* Linné (1758).

350.—*Squatina* C. Duméril (1806).—*Squalus squatina* Linné (1758).

351.—*Pristis* Latham (1794, or of Linck, 1790).—*Pristis antiquorum* Latham (1794) = *Squalus priscus* Linné (error for *pristis* Linné, 1758).

TAXONOMIC NOTES ON SHARKS AND RAYS.

By Gilbert P. Whitley.

(*By Permission of the Trustees of The Australian Museum.*)

(Plates xx.-xxii. and text-figs. 1-18.)

In preparing a popular handbook to the sharks and rays of Australia which, it is hoped, will soon be submitted to the Royal Zoological Society of New South Wales for printing, I have come across several noteworthy synonyms, new species, and other technical details which would better appear in another publication, and are accordingly assembled here.

Since "Notes on Some Australian Sharks" was published in the Memoirs of the Queensland Museum, Vol. x., 1934, pp. 180-200, I have collected further specimens in Queensland, on the Middleton and Elizabeth Reefs, and in Western Australia, and have examined specimens and literature in New Zealand, England, Europe, and the United States. My thanks are extended to all the many friends and colleàgues who helped me, both in the field and in museums and libraries. I am indebted to Miss Joyce Allan and Miss Mary Soady for their artistic and accurate illustrations, and to Mr. G. C. Clutton for photographs.

References to literature, not repeated in these notes, will be found in McCulloch's Check-List of the Fishes recorded from Australia (Austr. Mus. Mem., v., 1929), or in the Memoirs of the Queensland Museum already quoted.

Family Heterodontidae.

Genus Heterodontus Blainville, 1816.

Blainville's original description is not available in Australia, but I copied it out in London, as follows:—

"*Heterodontus*: Car. Dent. heteroclitis; Insp. nullis; P.S. 2 ut in praecedenti [i.e., in *Acanthorhinus*—G.P.W.]; P.A. magna; P.C. ferè ut in praeced. *Spec.* Philippi."

Heterodontus portusjacksoni (Meyer).

Add to synonymy: *Squalus philipp* Anon., Allgemeine Literatur-Zeitung, Band iii., No. 287, September 24, 1798; publication consulted in the British Museum, Bloomsbury, London.

Family Hemiscylliidae.

Genus Parascyllium Gill, 1862.

Neoparascyllium, *subg. nov.*

Orthotype, *Parascyllium multimaculatum* Scott (Proc. Roy. Soc. Tas., 1934 (1935), p. 63, pl. v., fig. 1, from Tamar Heads, Tasmania).

First dorsal fin inserted behind the middle of the total length. Colour pale grey, tinged with brown, becoming almost white below. Ten rather diffuse rusty brown bars on sides; sides and back with numerous small dark brown spots.

CHILOSCYLLIUM (SYNCHISMUS) COLAX (Meuschen).

The species usually called *Chiloscyllium indicum* should be cited as above, since Meuschen named it *Squalus colax* in the Index to Gronow's Zoophylacium, Pisces, 1781, before Gmelin called it *Squalus indicus* in 1789.

Family ORECTOLOBIDAE.

SUTORECTUS, *gen. nov.*

Orthotype, *Crossorhinus tentaculatus* Peters, 1864, s. str. from South Australia.

Differs from true *Crossorhinus* = *Orectolobus* in having the nasal cirrhus simple instead of lobed or branched. Dorsal surface with rows of prominent tubercles or papillae. The interdorsal space is narrower than in most

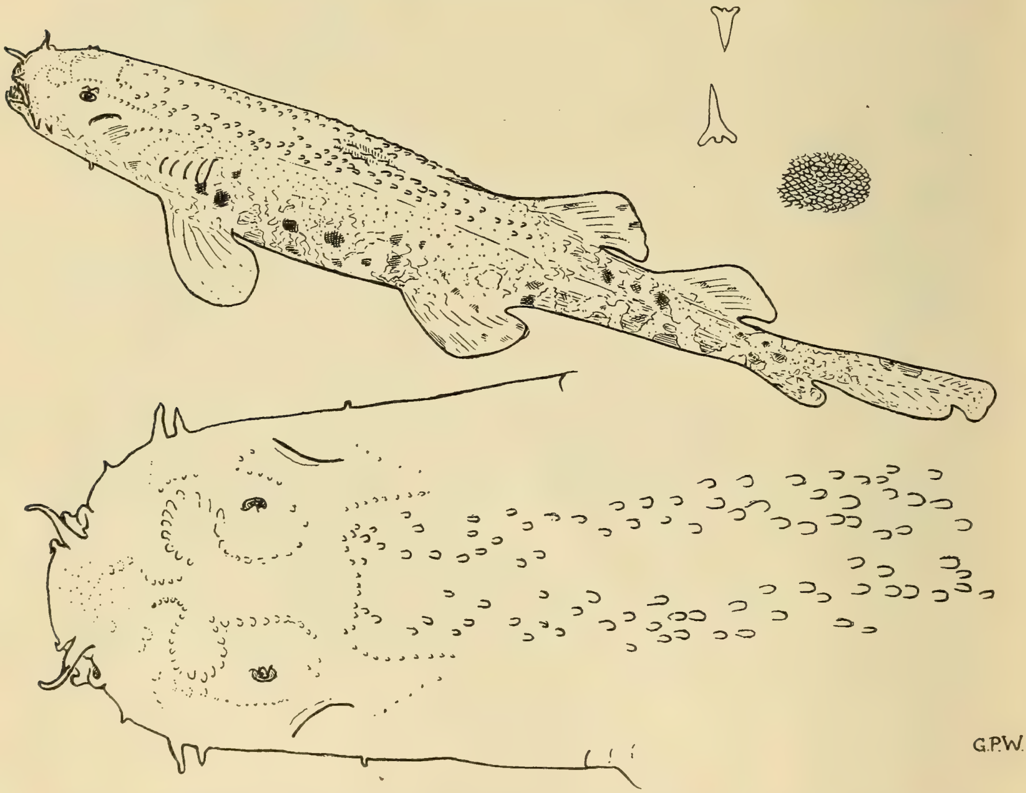


Fig. 1. *Sutorectus tentaculatus* (Peters). A specimen from Port Adelaide, South Australia (Austr. Mus., Regd. No. I. 2352). . . G. P. Whitley *del.*

species of *Orectolobus*. Spiracles larger than eyes. Length up to three feet. Littoral in South and Western Australia, where it is generally known as "Cobbler". A South Australian specimen of *Sutorectus tentaculatus* is here figured (fig. 1).

STEGOSTOMA TIGRINUM NAUCUM, *subsp. nov.*

(Fig. 2.)

The Zebra Shark (*Stegostoma*) has a very extensive distribution and apparently variable colour-patterns. The typical Indian form is strikingly banded; the Australian Museum has such a specimen from Madras. But other specimens have been figured (e.g., by Tanaka, Delsman and Hardenberg and others) with small spots instead of bands. A spotted example, similar to these, from the Hawkesbury River, New South Wales, is accordingly made the type of a new subspecies, *naucum*; Austr. Mus., Regd. No. I. 4,174. It has the anal and subcaudal lobes more separated than shown in

Fig. 2. *Stegostoma tigrinum naucum* Whitley. (1) Holotype of subspecies (Austr. Mus., Regd. No. I.4174) from Hawkesbury River, New South Wales; (2) mouth-parts, (3) teeth, (4) denticles of holotype; (5 & 6) attitudes of a living Sydney specimen, and (7) egg-case from Queensland with byssus. . . . . G. P. Whitley *del.*

figures of the spotted forms and differs in fin-proportions, in having larger spots, and thicker nasal cirrhi. Teeth tricuspid; dermal denticles variable from smooth to keeled, the central keel largest. All the eastern Australian specimens I have seen are referable to *naucum*, but a Wyndham (W. Australia) specimen in the Perth Museum is banded like the Indian *tigrinum*.

Family SCYLIORHINIDAE.

Genus SCYLIORHINUS Blainville, 1816.

The type of this genus is the European *canicula*, from which all the Australian species differ sufficiently to be regarded as distinct genera. Thus *Aulohalaelurus* Fowler, 1934, is available for *labiosus* Waite, *Asymbolus*, gen. nov. for *Scyllium anale* Ogilby, and *Juncrus*, gen. nov. for *Scyllium vincenti* Zietz. Distinguishing characters will be found in the keys of Regan (Ann. Mag. Nat. Hist. (8), i., 1908, p. 454) and McCulloch (Zool. Res. Endeavour, i., 1911, p. 6). The Australian ones also differ in the disposition of the pores and ampullae on the head from the European *Scyliorhinus*, whilst in male *Juncrus*, the ventrals are in contact behind the claspers.

FIGARO BOARDMANI (Whitley).

Many specimens referable to this species are in the "Endeavour" collections from the eastern edge of Bass Strait; 100-200 fathoms, trawled in 1912. Also from the Great Australian Bight, south and west from Eucla in depths of 70 to 450 fathoms, caught in April, 1913. Curiously, all are males, up to about 16 inches in length, and the humped back is characteristic of the largest specimens. This species, hitherto known only from Southern New South Wales, evidently lives in deep water around Victoria, Tasmania, South and South-western Australia, growing to a length of two feet. The colour-bands of the Bight specimens (subspecies *socius,* nov.) are fainter than those of the holotype.

ATELOMYCTERUS MACLEAYI, *sp. nov.*

(Fig. 3.)

Mr. Melbourne Ward recently collected several specimens of the cat-shark previously listed from Northern Australia as *Atelomycterus marmoratus* (Raffles). These came from Melville Island, Northern Territory, and included a female with well developed egg-capsule. They confirm the suspicion that I have expressed (Rec. Austr. Mus., xviii., 1932, p. 322, pl. xxxviii., fig. 1) that the Australian form is not typical *marmoratus,* so I name it as above with the Australian Museum specimen figured in 1932 as holotype. Not only does *macleayi* differ from figures of the Indian *maculatum* (Gray, Illustr. Ind. Zool., i., 3, July, 1830, pl. 98, fig. 1, not *Squalus maculatus* Bonnaterre; Day, Fish. India, etc.) in coloration and relative positions of fins, but the egg of the Melville Island female is $2\frac{3}{4}$ by 1 ins., is constricted before the posterior end, and only bears tendrils posteriorly; in these respects the egg differs from that ascribed to the China Sea *marmoratus* by Smedley (Journ. Malay Branch Roy. Asiatic Soc., v., 1927, p. 355).

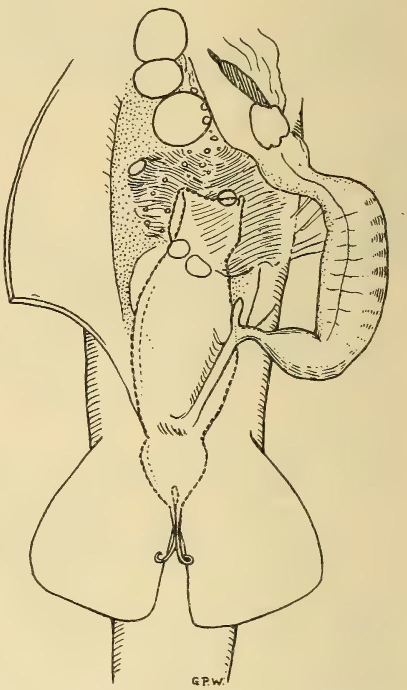


Fig. 3. *Atelomycterus macleayi* Whitley. Egg-case in *utero.* Melville Island, Northern Territory (Austr. Mus., Regd. No. IA. 7826). G. P. Whitley *del.*

Family GALEIDAE.

GALEOLAMNA GREYI, Owen.

The so-called Whaler Sharks have given me more trouble as regards their nomenclature and classification into species than any others. I have examined numerous specimens, yet would like to compare larger series to determine the limits of their variation. In their literature, every author

describing a species seems to use a different system of measurement or uses criteria disregarded by his colleagues, so that comparison of accounts is almost impossible. Sometimes only an odd jaw or some teeth are described or toothless embryos. Thus exhaustive study of the whalers, over some years, suggests that there may be one very variable species in Australia and New Zealand, or, as seems more likely, there is more than one species. The oldest name is *Galeolamna greyi* Owen, 1853, but the genus has been called *Carcharias, Carcharhinus* and *Eulamia* by Australian authors and my own genus *Galeolamnoides* falls as a synonym of *Galeolamna.* The latter name was proposed by Owen for a pair of jaws which I have examined in the Museum of the Royal College of Surgeons, England. The dental formula is 15.1.15 over 15.1.15; whilst the upper teeth are notched and serrated almost to their tips, the serrations on the lower jaw teeth are too minute to be seen by the naked eye, but can be felt. There are two small symphyseal teeth in each jaw, and the specimen is a South Australian Cocktail or Whaler Shark.

In the British Museum (Nat. Hist.), I examined Gunther's foetal specimens labelled "? Squalus (Carcharias brachyurus) J. B. Jukes, Esq." and "Squalus ? brachyurus, S. Australia". The snouts were buckled and the bodies rather twisted after their long preservation so that exact measurements could not be taken and, of course, they showed no dental characters. They were, however, Whaler Sharks, and the name *brachyurus* Gunther, 1870, is available for the New Zealand Whaler, if distinct from the Australian *greyi.*

The holotype of *Carcharias macrurus* Ramsay & Ogilby, 1887, from Port Jackson, is a small skin in the Australian Museum. It also is a Whaler. Waite's figure of *C. brachyurus* (Rec. Austr. Mus., vi., 1906, p. 226, pl. xxxix.) differs and appears to represent *stevensi* Ogilby; if so, this is a new record for New South Wales. Both *spenceri* and *stevensi* Ogilby, are "good" species, and the latter deserves subgeneric separation as *Ogilamia,* subg. nov. A Western Australian form has not yet been satisfactorily determined. Mr. D. G. Stead has recently published the best description of a Whaler Shark which has so far appeared, when describing the Bronze Whaler, *Galeolamna ahenea.*

LONGMANIA, *gen. nov.*

Orthotype, *Carcharias (Aprion) brevipinna* Muller & Henle.

Differs from typical *Aprionodon* (genotype, *Carcharias (Aprion) isodon* M. & H. from America) in having an elongate, tapering snout; second dorsal smaller than anal, with its origin a little behind that of anal; and origin of first dorsal fin above inner angle of pectoral fin.

Named after Mr. Heber A. Longman, Director of the Queensland Museum, Brisbane, who has generously placed at my disposal many specimens of elasmobranchs and fishes in the last fifteen years.

LONGMANIA BREVIPINNA (Muller & Henle).

(Fig. 4.)

Carcharias (Aprion) brevipinna Müller & Henle, Syst. beschr. Plagiost. (2), 1839, p. 31, pl. ix., Java., *Aprionodon brevipinna* of modern authors.

Nictitating membrane present. Nostrils small, narrow. No spiracle. Snout elongate, acute. Rictus twice as broad as long. Teeth in upper jaw nearly erect, not serrated on base or cusp. In the lower jaw, the teeth are smaller, narrower, erect, entire, acute and with broad bases.

There appear to be no diminutive teeth at symphyses. Gill-slits wide, the last over pectoral. General form and proportions as in accompanying figure. Body with close-set denticles, each with about five carinae. Second dorsal fin smaller than anal and originating behind level of anal origin. Caudal pits present.

Greyish-blue above and on the fins. White below. A diffuse band of greyish-blue near middle of side of body as in some whaler sharks. Upper caudal pit smoky grey. Eye bluish.

Fig. 4. *Longmania brevipinna* (Müller & Henle). An immature male from Cape Cleveland, Queensland (Qld. Mus., Regd. No. I. 6714). .. .. G. P. Whitley *del.*

Described and figured from an immature male, 780 mm. or about 31½ inches long, from Cape Cleveland, Queensland. Qld. Mus., Regd. No. I. 6714; presented by Mr. George Coates. Hitherto only recorded from the East Indies (Java) and Japan, this species may now be added to the Australian fauna.

Genus NEGOGALEUS Whitley, 1931.

Negogaleus Whitley, Austr. Zoologist, vi., February 13, 1931, p. 334. Orthotype, *Hemigaleus microstoma* Bleeker. New name for *Hemigaleus* Bleeker, 1852, regarded as preocc. by *Hemigalea* Blainville, 1837, and *Hemigalus* Jourdain, 1837, in Mammalia.

NEGOGALEUS MICROSTOMA (Bleeker).

(Fig. 5.)

Hemigaleus microstoma Bleeker, Verh. Bat. Gen., xxiv., 1852, Plagiost., p. 46, pl. ii., fig. 9. Batavia. *Id.* of later authors.

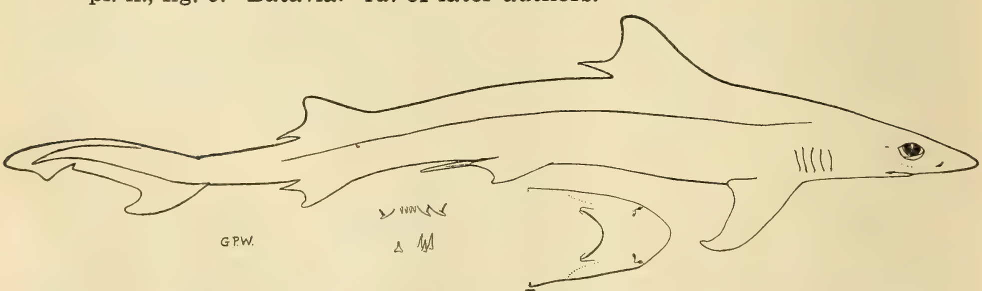


Fig. 5. *Negogaleus microstoma* (Bleeker). Male from Salamander Rocks, Queensland (Qld. Mus., Regd. No. I.6667). .. .. G. P. Whitley *del.*

Eye with nictitating membrane. A tiny slit-like spiracle. Mouth crescentic, with labial folds. Teeth of the upper jaw oblique, strongly serrated on their outer margins; the lower jaw teeth much smaller, erect, narrow, on broad bases, not serrated. Teeth at symphyses smaller than lateral ones. Body elongate. Denticles rough, each with several carinae. The large anal fin originates behind the level of the second dorsal origin. A long caudal peduncle with pit above and below. Silver above, with grey, pink, or bluish reflections from the rough shagreen; white below. No black or white marks on fins.

A male specimen, 28½ inches long, was identified as this species by Mr. T. C. Marshall, of the Queensland Museum, and sent to me for purposes of illustration and record. Whilst known from several localities in the East Indies, this is the first notice of *Negogaleus* from Australia, and the species seems never to have been figured full-length before. Ours differs a little in proportions and colour from Bleeker's description, but not enough to justify specific separation.

Locality.—Salamander Rocks, North Queensland; Mr. George Coates. Queensland Mus., Regd. No. I. 6,667.

New record for Australia.

APRIONODON ACUTIDENS QUEENSLANDICUS, *subsp. nov.*

(Fig. 6.)

No spiracles. Nictitating membrane present. Upper labial fold short, lower labial fold minute. Teeth long, erect, acute, entire, with broad smooth bases. Small teeth at symphyses. Denticles mostly tricarinate. Dorsal

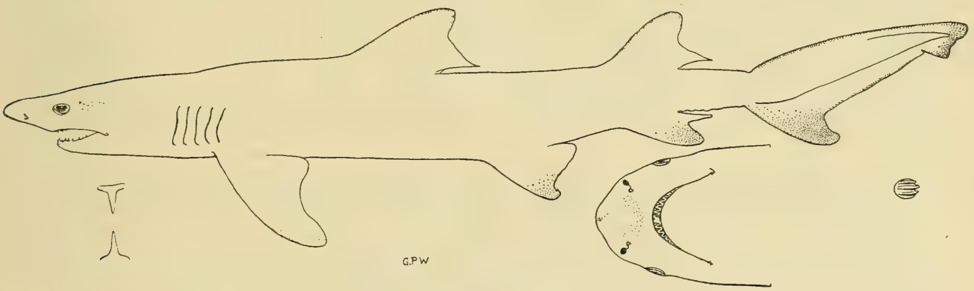


Fig. 6. *Aprionodon acutidens queenslandicus* Whitley. Female holotype of subspecies from Townsville, Queensland (Qld. Mus., Regd. No. I.6189) . . . . G. P. Whitley *del.*

origin behind level of inner pectoral angle. Second dorsal larger than anal with its origin in advance of anal origin. Caudal pits above and below. Some lumps above and below caudal peduncle, on anal and caudal fins, and elsewhere perhaps due to disease or parasites.

General characters as in *Carcharias acutidens* Rüppell (Neue Wirbelth. Abyssin. Fische, ii., 1837, p. 65, pl. xviii., fig. 3, from Djetta, Red Sea) but snout is more acute, ventral fins are comparatively larger, and the inferior margin of the upper lobe of caudal fin is more produced.

Described and figured from the holotype of the subspecies, a female 645 mm. or nearly 26 inches long.

Locality.—Townsville, North Queensland; Mr. George Coates. Queensland Mus., Regd. No. I. 6,189.

A slightly larger male paratype, with very dark tips to fins, is in the Queensland Museum (No. I. 5975) from the same place, also two small females: one (I. 6117) from Cape Cleveland (G. Coates) and the other (I. 5577) collected by Mr. H. A. Longman in Moreton Bay.

Apparently this shark is not uncommon along the Queensland mainland coastline.

PLATYPODON COATESI, *sp. nov.*

(Fig. 7.)

Head with conspicuous pores, blunter snout and larger nostrils than in the genotype of *Platypodon* (i.e., *Carcharias menisorrah* Muller & Henle, Syst. beschr. Plagiost., ii., 1839, p. 46, pl. xvii., from Java, New Holland and the Red Sea). Rictus rather angular, broader than long. Erect, compressed teeth in upper jaw, each with one large central cusp (not serrated

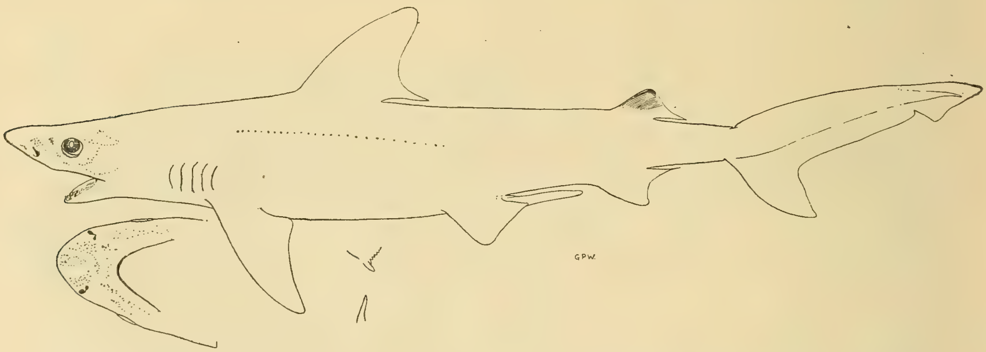


Fig. 7. *Platypodon coatesi* Whitley. Male holotype from Hinchinbrook Passage, Queensland (Qld. Mus., Regd. No. I.6226). G. P. Whitley *del.*

to tip and sometimes not serrated at all), notched, with six or seven strong serrations on one side of the base and on the other a less strongly serrated convex edge. Lower jaw teeth curved, flexuous, acute, sloping outwards, entirely without serrae. No spiracle. Eye large, with nictitating membrane. Nostrils large, with broad flaps. Third gill-slit widest. General form and proportions as in the accompanying figure. Denticles of body very small with four or five carinae instead of three as in *menisorrah*. Dorsal fin over pectoral-ventral interspace, nearer pectoral. Second dorsal subequal to anal, its origin further back than anal origin. A crescentic caudal pit above and below.

Colour satiny grey above with a violaceous tinge on fins. A large dark brown blotch on anterior half of second dorsal fin.

Described and figured from the holotype of the species, a male, 31 inches long; Queensland Mus., Regd. No. I. 6,226.

Locality.—Hinchinbrook Passage, Queensland; Mr. George Coates.

This shark seems near *Platypodon menisorrah*, but differs in tooth and denticle characters. Possibly Muller & Henle's type came from the Red Sea

and Eastern Australian records of *menisorrah* are referable to this new species, which I name in honour of Mr. George Coates, who has collected many interesting elasmobranchs and large fishes in North Queensland.

SCOLIODON JORDANI, Ogilby.

(Fig. 8.)

The accompanying figure shows a 33 inch female from Lindeman Island, Queensland, caught on 13th August, 1935, with the embryo curled in the

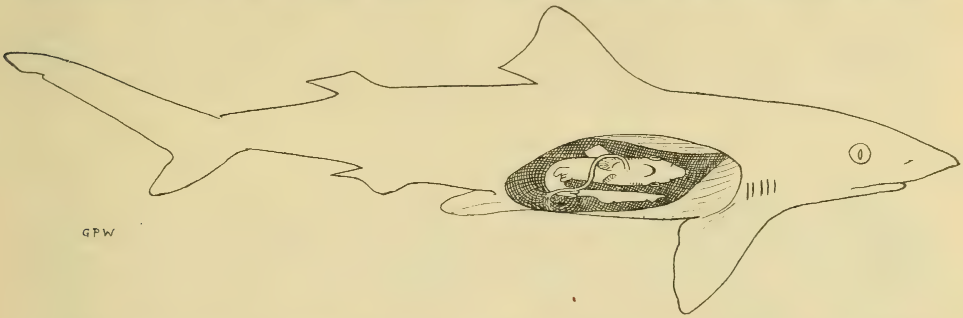


Fig. 8. *Scoliodon jordani* Ogilby. Female and embryo from Lindeman Island, Queensland .... G. P. Whitley *del.*

uterus (shaded); a second embryo was unfortunately destroyed by fishermen. The figured foetus is preserved in the Australian Museum (Regd. No. IA. 6681) together with the head of the mother (IA. 6569). The embryo was 4½ inches curled, but 8½ inches when straightened out. The umbilical cord, 6½ ins. long, was firmly attached to the uterine walls and villi by a boot-shaped or bi-lobed "placenta". There were no external gills.

I saw a second specimen of this species at Lindeman Island on 26th August, 1939. The female here figured shows some slight variation in proportions from the males I illustrated in Mem. Qld. Mus., x., 1934, p. 186, figs. 2 and 3, but these differences may be due to sex or variation.

RHIZOPRIONODON CRENIDENS (Klunzinger).

Through the kindness of Dr. M. Rauther, I was enabled to see the female holotype of *Scoliodon crenidens* Klunzinger from Queensland in the Württembergische Naturaliensammlung, Stuttgart (No. 2,449), also a second smaller specimen received from Baron von Müller in 1891. The head is somewhat distorted and the teeth are not as noticeably serrated as Klunzinger's figure shows, and it is possible that *Scoliodon jordani* (forma *longmani*) may be a synonym, except that I have never seen a specimen of *jordani* with serrated teeth. Approximate measurements of the holotype of *crenidens* in millimetres are: Head, 120; interorbital, 40; snout to first dorsal, 170; base of first dorsal, 50; interdorsal space, 150 (shrunken); upper caudal lobe, 155; snout to mouth, at least, 48; snout to pectoral, *c.* 120? Pectoral nearly 70; pectoral to ventral, 150. Dorsal origin nearer pectorals than ventrals. Anal larger than second dorsal. Pectoral reaching to level of two-thirds dorsal base.

Genus Triaenodon Muller & Henle, 1837.

Triaenodon Müller & Henle, Ber. Verh. k. pr. Akad. Wiss. Berlin, ii., 1837, p. 113 and Mag. Nat. Hist. (ed. Charlesworth), n.s., ii., 1838, p. 36 (genus caelebs); Syst. Plagiost., 1839, p. 55. Genotype, *Carcharias obesus* Rüppell.

This genus is characterised by having tricuspid teeth, a large second dorsal fin, and white-tipped dorsal and caudal lobes. It is now recorded from Australia for the first time, having been known before from the Red Sea, Indian Ocean, East Indies, and South Sea islands from the New Hebrides to Hawaii, Tahiti, and Cocos Island. Specimens up to ten feet long have been mentioned but the Australian species, regarded as new, is only about 2½ feet long, as far as is known.

Triaenodon apicalis, *sp. nov.*

(Fig. 9.)

Head one-fifth of total length; it is much depressed and longer than wide. Snout broadly rounded. Eye rather small, ovate, free from orbital margin and with well developed nictitating membrane and small pupil. Nostrils large, less than eye-diameter, oblique, gaping, nearer eye than tip of snout, with broad round anterior flaps and minute posterior ones. Mouth inferior, parabolic, much wider than long. Rictus grooved but labial folds obsolescent. Numerous backwardly-directed teeth each with three entire

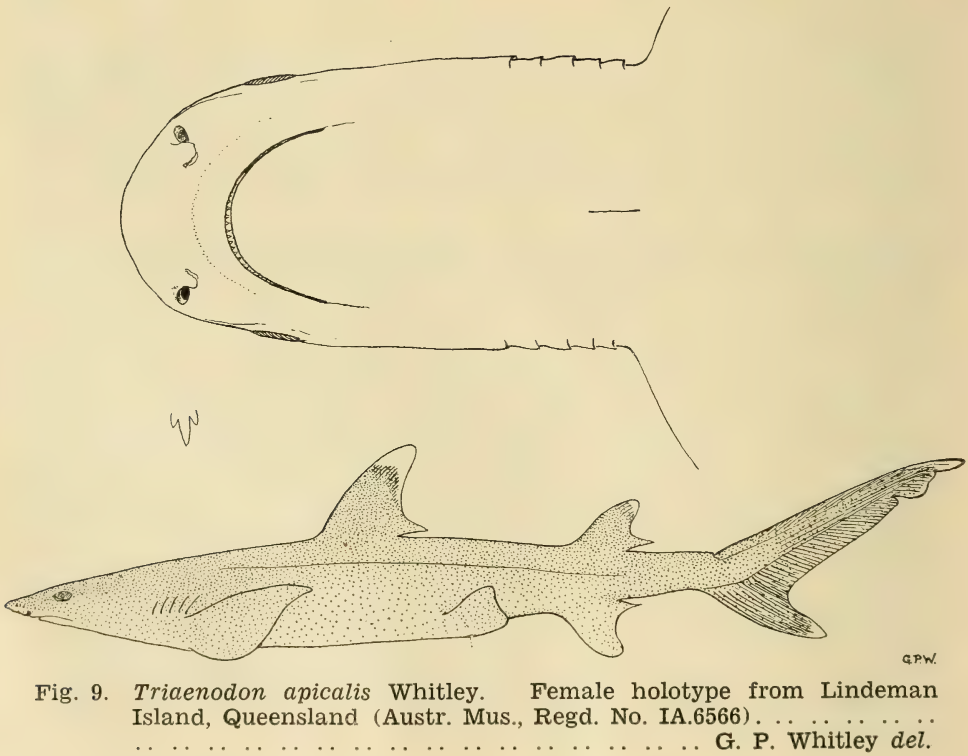


Fig. 9. *Triaenodon apicalis* Whitley. Female holotype from Lindeman Island, Queensland (Austr. Mus., Regd. No. IA.6566). . . . . G. P. Whitley *del.*

acute cusps, the central one longest; they are similar in both jaws, of moderate size, small at symphyses. No spiracles. Auditory openings conspicuous on vertex. Five gill-slits, all longer than eye, increasing in size posteriorly, last one over pectoral base and sloping obliquely backwards.

The following measurements are approximate, since the specimen is curled. Total length, 700 mm. Head, 140. Snout to first dorsal origin, 225; to second, 420; to caudal root, 510. Depth, 72. Upper caudal lobe, 184. Vent to tip of snout, 340; to tip of tail, 370. Eye, 15. Interorbital, 69. Width of head, 78; its height, 43. Snout, 31. Eye to first gill-opening, 57. Internarial, 27, equals preoral length, 27. First dorsal base, 48; its oblique height, 97. Second dorsal base, 41; height, 56. Interdorsal space, 123. Second dorsal to caudal pit, 60. Anal to caudal pit, 54. Pectoral fin, 97.

Body elongate, about as broad as high anteriorly, but higher than broad further back. Belly rounded. Back with slight median depression. Caudal peduncle ovate in cross-section. A pronounced caudal pit above and an indistinct one below. Integument of coarse shagreen of more or less imbricate rhomboid denticles varying considerably from smooth to scalloped or tri-carinated on different parts of the animal. Lateral line inconspicuous except along middle of sides. Umbilical scar still present. Vent a little nearer tip of snout than end of tail.

First dorsal fin larger than second, its base over the pectoral-ventral interspace. Second dorsal well developed, its base very slightly before that of anal fin anteriorly. Pectorals moderate, just reaching level of first dorsal origin, and subequal in length to height of first dorsal fin. Ventrals small. Caudal fin tapering, the lobed tip overhanging a triangular lobe; lower caudal lobe about half the length of the upper. Abdominal pores papilliform.

Colour greyish to brownish grey, tinged pinkish on parts of head and body; the darkest grey is on the back and the belly is a whitish-grey. Eye blue. All dorsal and caudal lobes with conspicuous milky-white tips; anterior edges of fins dusky. Some irregular dusky blotches on and near ventral fins.

Described from the holotype, an apparently immature female specimen, 28 ins. or 700 mm. long, preserved in formalin. Austr. Mus. Regd. No. IA. 6,566.

Locality.—Lindeman Island, North Queensland; September, 1935. Melbourne Ward and G. P. Whitley coll.

A paratype is similar, with same data, and the Museum has another specimen from the Sir Edward Pellew Islands, Gulf of Carpentaria, Northern Territory.

This new species is allied to *Carcharias obesus* Rüppell (Neue Wirbelt. Abyssin., Fische, ii., 1837, p. 64, pl. xviii., fig. 2) from the Red Sea, but differs in the shape of the snout and mouth and in having the first dorsal fin nearer the pectorals. *Triaenodon obtusus* Day (Fish. India, 1878, p. 720, pl. clxxxix., fig. 3), from Kurrachee, has blunter snout, wider mouth, and differently shaped caudal fin. A Hawaiian ally has been figured by Fowler (Mem. Bish. Mus., x., 1928, p. 22, fig. 7).

This shark is probably viviparous and harmless to man.

Genus Mustelus Linck, 1790.

From Hubbs' recent discussion on the taxonomy of this genus, it might appear that the earliest name for it is *Galaeus* Müller (Deliciae Naturae

Selectae (Knorr), ii., 1767, p. 55—*fide* Hubbs, Occas. Pap. Mus. Zool. Univ. Mich., 374, 1938, p. 7), but Iredale (Proc. Malac. Soc. London, xv., 1922, p. 78) after a study of the Deliciae, found that the names in it were non-Linnean, so *Galaeus* has no standing, and *Mustelus* may be employed as usual, unless regarded as preoccupied by *Mustela* Linné, 1758, the Weasel. *Galeus* Rafinesque, 1810, is based on *G. melastomus* Raf., which is therefore the genotype, not *Squalus galeus* Linné. Also *Galeorhinus* Blainville, 1816, does not concern *Mustelus,* because its type was designated as *galeus* by Gill in Ann. Lyc. Nat. Hist. N. York, vii., 1862, p. 402, though, much earlier, Bosc had said of it (Nouv. Dict. Hist. Nat., nouv. ed., xii., July, 1817, p. 377), "Les Squales milandre [= *galeus*] et Emissole [= *mustelus*] lui servent de type". Thus with *Galeus* and *Galeorhinus* eliminated, the first synonym of *Mustelus* is *Mustellus* Fischer-Waldheim (Zoognosia, ed. 3, i., 1813, p. 78), with *Squalus mustelus* as logotype. *Mustellus* should not be confused with *Mustella* Bosc., 1818, preocc. in mammals by Scopoli, 1777, and *Mustela* Cloquet, 1824, preocc. in mammals by Linné, 1758; the latter names refer to rocklings of the family Gadidae. *Mastelus* Partington (Brit. Cyclop. Nat. Hist., iii., 1837, p. 650) and *Mustelas* Lankaster (Engl. Cyclop. (Knight), iv., 1856, p. 886, ex Penny Cyclop.) are however variants of *Mustelus,* the shark. Because of these various spellings, genders, and employment of similar names for sharks, weasels, and rocklings, it seems reasonable to regard *Mustelus* Linck as preoccupied by *Mustela* Linné, and use the next valid name, *Emissola* Jarocki, 1822. Hubbs appears to have overlooked the name *Myrmillo* Gistel (Naturg. Thierr. höh. Schulen, 1848, p. x.), proposed for the shark, *Mustelus* Cuv., regarded as preocc. by *Mustela* Linné; the only species mentioned by Gistel is *M. vulgaris,* that is *M. mustelus* (Linn.). The name *Pleuracromylon* Gill, 1864, is a synonym of *Mustelus* Linck, but *Cynias* Gill, 1903, still remains as the first valid name for the Spotted Dogfish identified by Hubbs as *Mustelus asterias* Cloquet.

EMISSOLA MAUGEANA, *sp. nov.*

(Fig. 10.)

Size large for the genus. Form elongate. Tail shorter than head plus body; the body robust. A median carina along back from level of pectorals, between the dorsals, to tail. Head depressed, snout acutely rounded. Eyes large, placed midway between tip of snout and first gill-opening, and with well developed nictitating membranes. Spiracles small oblique slits. Nostrils large, nearer mouth than tip of snout. Mouth opening in advance of eye level, its angle of occlusion more than 90°. Outer labial folds reaching further forward than inner ones. Teeth paved, in broad scrolls with several functional series, each with a slightly raised blunt crown but no cusps so that the functional profile is a blunted obtuse angle. Third gill-slit longest.

Denticles of side of body (from a point equal to horizontal diameter of orbit below origin of first dorsal) with two or three (sometimes four) ridges, these generally reaching almost to posterior edge. Denticles on belly smaller, and without carinae. The unique holotype is curled so that the following measurements are approximate.

Total length, 915 mm.
Tip of snout to anterior margin of orbit, 72.
Tip of snout to front of mouth, 57.5.
Tip of snout to outer angle of nostril, 42.
Tip of snout to first gill-opening, 162.

Tip of snout to fifth gill-opening, 195.
Horizontal diameter of orbit, 26.
Vertical diameter of orbit, 14.
Interorbital, 70.
Width of head, 104.
Width of mouth (angle to angle), 54.
Internarial, 27.
Depth of body, about 98 mm.
Snout to first dorsal origin, circa 270.
Interdorsal, circa 210.
First dorsal fin: anterior margin, 107; posterior margin, 44; base, 89.
Second dorsal fin: anterior margin, 80; posterior margin, 0; base, 75.
Second dorsal fin to beginning of caudal, 100.
Anal fin: anterior margin, 62; posterior margin, 21; base, 53.
Pectoral fin: outer margin, 144; inner margin, 75; base, 45.
Upper caudal lobe, 180.
Lower caudal lobe, 74.
Tip of caudal to notch, 85.

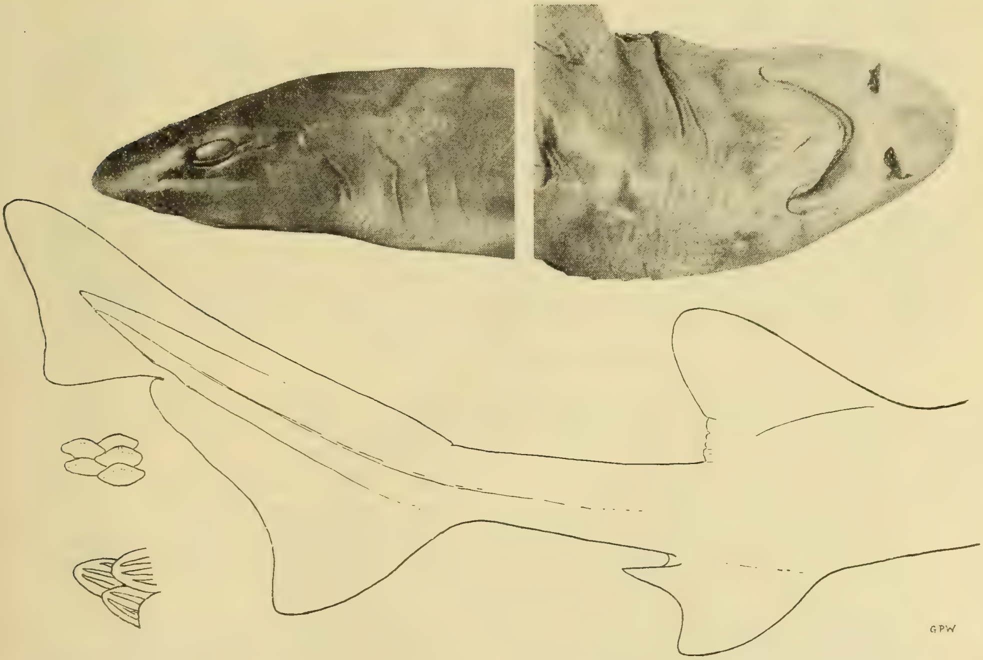


Fig. 10. *Emissola maugeana* Whitley. Holotype from off Flinders Island, Tasmania (Austr. Mus., Regd. No. IA.1922). .. .. G. C. Clutton *photo* and G. P. Whitley *del.*

Origin of first dorsal fin well behind level of base of pectorals. Posterior margin of second dorsal fin fused with back (doubtless abnormal). Anal

fin smaller than dorsals. Lower caudal lobe fairly well developed, rounded.

Colour (in formalin), uniform dark grey above, lighter below. No white spots. A dark blackish band with ragged edges along middle of each side below lateral line.

Described and figured from the unique holotype of the species, a female, 915 mm. or three feet long, from off Flinders Island, Tasmania; collected by the late W. E. J. Paradice in 1923 or 1924. Australian Museum, Regd. No. IA. 1,922.

Family LAMNIDAE.

LAMNA WHITLEYI, Phillipps.

(Fig. 11.)

Lamna whitleyi Phillipps, New Zeal. Journ. Sci. Tech., xvi., 4, January, 1935, p. 239, fig. 3. Wellington and Nelson, New Zealand.

The accompanying figure represents the teeth from the type-specimen in the Dominion Museum, Wellington.

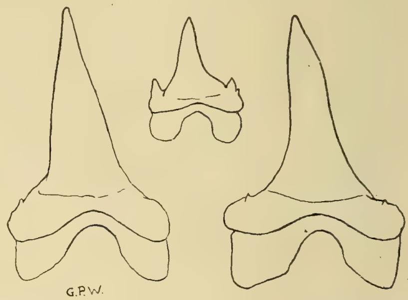


Fig. 11. *Lamna whitleyi* Phillipps. Teeth from holotype, New Zealand. G. P. Whitley *del.*

SQUALICORAX, *gen. nov.*

Orthotype, *Galeus pristodontus* Agassiz, 1835.

A new name is necessary for the shark called *Corax,* because Mr. T. Iredale informs me that Agassiz' name is preoccupied by *Corax* Ledru (Voy. Ténériffe, ii., 1810, p. 204), a generic name for the Raven. The orthotype of my new genus is *Galeus pristodontus* Agassiz (Poiss. Foss., Feuilleton, 54, 1835) = *Corax pristodontus* Agassiz (Poiss. Foss., iii., 1843, p. 224) = *Squalicorax pristodontus.*

CARCHARODON ALBIMORS, *sp. nov.*

? *Squalus carcharias* Labillardiere, Voy. rech. La Perouse, i., 1800, pp. 276 & 399 (New Guinea and S.W. Australian coast). Not *Squalus carcharias* Linné, Syst. Nat., ed. 10, 1758, p. 235, from Europe.

Carcharias leucas Bennett, Proc. Zool. Soc. Lond., xxvii., 1859, p. 223 (Port Jackson. Specimen in Austr. Mus.). *Id.* Jouan, Mem. Soc. Imp. Sci. Nat. Cherbourg, xiv., 1869, p. 85 (Auckland, N.Z.). Not *Carcharias* (*Prionodon*) *leucas* Müller & Henle, Syst. Plagiost. (2), 1839, p. 42, *ex* Valenciennes, MS., from the Antilles.

Carcharodon rondeletii Müller & Henle, Syst. Plagiost. (2), 1839, p. 70 ("Neuholland" record only; not type from Mediterranean and Atlantic). *Id.* Gunther, Cat. Fish. Brit. Mus., viii., 1870, p. 392. *Id.* Hutton, Colon. Mus. & Geol. Surv. Dept. Publ., xviii. (Cat. Fish., N.Z.), 1872, p. 78. *Id.* Klunzinger, Sitzb. Akad. Wiss. Wien., lxxx., 1, 1879, p. 426. *Id.* Gunther, Stud. Fish., 1880, p. 320, fig. 114. *Id.* Macleay, Proc. Linn. Soc. N.S.W., iv., 1880, p. 459; Cat. Austr. Fish., ii., 1882, p. 294. *Id.* Ramsay, Proc. Linn. Soc. N.S.W., v., 1880, p. 96. *Id.* Tenison-Woods, Fish. Fisher. N.S.W.,

1882, p. 25. *Id.* McCoy, Prodr. Zool. Vict., viii., 1883, p. 19, pl. lxxiv. *Id.* Haswell, Proc. Linn. Soc. N.S.W., ix., 1884, p. 83, pl. i., figs. 1-4 (skeleton). *Id.* Ogilby, Cat. Fish. N.S.W., 1886, p. 2. *Id.* Parker, Proc. Zool. Soc. Lond., 1887, p. 27, pls. iv.-viii. (anatomy). *Id.* Ogilby, Proc. Linn. Soc. N.S.W. (2), iii., 1889, p. 177. *Id.* Lucas, Proc. Roy. Soc. Vict. (2), ii., 1890, p. 43.

Carcharias maso [sic] Morris, Austral English, 1898, p. 412. New Zealand. Not *Squalus* (*Carcharias*) *maou* Lesson, Voy. Coquille, Zool., ii., 1, 1831, p. 91, pl. i., from the Paumotu Islands.

Carcharodon carcharias Waite, Mem. N.S.W. Nat. Club, ii., 1904, p. 8, and Rec. Canterb. Mus., i., 1907, p. 6. *Id.* Stead, Fish. Austr., 1906, p. 233. *Id.* Zietz, Trans. Roy. Soc. S. Austr., xxxii., 1908, p. 291. *Id.* Stead, Lone Hand, Dec., 1913, p. 35. *Id.* Ogilby, Mem. Qld. Mus., v., 1916, p. 74. *Id.* Smith, Amer. Mus. Journ., xvi., 1916, p. 342, figs. *Id.* McCulloch, Austr. Zool., i., 7, 1919, p. 223; Austr. Zool. Handb., i., 1922, p. 8 (not figs.). *Id.* Waite, Rec. S. Austr. Mus., ii., 1921, p. 21; Fish. S. Austr., 1923, p. 40 (not fig.). *Id.* Phillipps, N.Z. Journ. Sci. Tech., vi., 1924, p. 269, fig. 14. *Id.* McCulloch & Whitley, Mem. Qld. Mus., viii., 1925, p. 129. *Id.* Whitley, Austr. Mus. Mag., iii., 1926, p. 13. *Id.* Roughley, Austr. Mus. Mag., iii., 1927, p. 152. *Id.* Phillipps, Mar. Dept. Fish. Bull., i., 1927, p. 9. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, p. 15. *Id.* Coppleson, Med. Journ. Austr., 1933, p. 458, figs. ii. (3), and vi. (b). *Id.* Stead, N.S.W. Rod Fishers' Gazette, Dec., 1935, p. 9, and of angling and sporting papers since. *Id.* Tubb, Proc. Roy. Soc. Vict., xlix., 1937, p. 422. *Id.* Grey, Amer. Angler in Austr., 1937, p. 48, pls. 34-35. *Id.* Young & Mazet, Shark! Shark! *Id.* Chapman, Open Air Stud. Austr., 1929, p. 70, pl. opp. p. 68.

Carcharhinus carcharias Whitley, Mem. Qld. Mus., x., 1934, p. 199.

The above is the bibliography of the Australian and New Zealand White Death or White Pointer Shark, known as Mango-tuatini or Hare Hongi in Maori. Very large specimens have been caught off South Australia and Victoria, whence McCoy figured a specimen and noted differences in the form and position of the fins in comparison with the European *carcharias*. A large New South Wales specimen is in the Australian Museum, as noted by Bennett, and may be regarded as type of *albimors*.

Family Halsydridae.

Halsydrus maximus (Linné).

This species has received many different names, as follows:—

Squalus maximus Linné, 1758; *Halsydrus pontoppidiani* Fleming, 1809; *Tetroras angiova* Rafinesque, 1810; *Squalus gunnerianus* Blainville, 1810; *Squalus homianus* Blainville, 1810; *Squalus peregrinus* Blainville, 1810; *Cetorhinus gunneri* Blainville, 1816; *C. shavianus* Blainville, 1816; *Scoliophis atlanticus* Anon., 1817; *Squalus rostratus* Macri, 1819; *S. isodus* Macri, 1819; *S. elephas* Le Sueur, 1822; *Selache maxima* Cloquet, 1825 et auct.; *Selachus rhinoceros* Dekay, 1842 (*ex* Mitchill, newspaper name, 1828); *Cetorhinus maximus* Gray, 1851, et auct. recen.; *Squalus cetaceus* Gray, 1854; *Polyprosopus rashleighanus* Couch, 1862; *P. macer* Couch, 1862; *Cetorhinus blainvillei* Capello, 1869; *Hannovera aurata* Van Beneden, 1871; *Selache pennanti* Noetling, 1885; *S. glauconitica* Noetling, 1885; *Tetroras maccoyi* Barrett, 1933 (the Australasian form).

Family Squalidae.

Leius ferox, Kner.

A specimen found dead, floating off Sydney Heads, April 25, 1939, and presented to the Australian Museum by Mr. D. G. Stead, constitutes a new record for New South Wales. Its length was 16½ inches, but this Museum has others up to 18 inches long from Lord Howe Island. The liver was large and yielded a very clear limpid oil. This species is probably luminous in life. The dorsal fins are small, without spines, the first very slightly in advance of the ventrals. Colour greyish brown, lighter below except for a collar-like greyish brown band across the throat below gill-slits. Mouth and tips of fins white. I saw a specimen of this species caught by the "Dana" in the Tasman Sea on February 23, 1929.

Somniosus antarcticus, *sp. nov.*

Somniosus sp. Waite, Australas. Antarct. Exped., 1911-14, Sci. Rept. (C), iii., 1, 1916, p. 51, fig. 10.

There appear to be no sharks whatever recorded from the Antarctic Continent, but a curious shark was found cast up on the beach of Macquarie Island in 1912. A sketch of it was made by a Mr. Hamilton and was reported upon by Waite. It was 8 ft. 2 ins. long and had a stout body; two dorsal fins, apparently without spines, and in normal position; no anal fin; eye small; snout short; mouth inferior; five small gill-openings; caudal fin short. There were 44 raptorial teeth in the upper jaw and 56 sectorial ones in the lower; no median tooth. Scales small, non-imbricate, slightly hooked tubercles.

Genus Squalus Linné, 1758.

The species of this genus from Australia and New Zealand are referable to two well-defined groups, each worthy of a new subgeneric name:—

A. Eye about 4 in head, subequal to snout. Origin of first dorsal fin nearer snout than origin of second, above or a little behind level of base of pectoral. Body uniformly coloured. .. .. .. *Flakeus*, nov.

AA. Eye 6 or more in head, much shorter than snout. Origin of first dorsal fin nearer that of second than to snout, well behind level of pectoral base. Body with large white spots. .. .. *Koinga*, nov.

The genotype of *Flakeus* is *Squalus megalops* Macleay and the subgenus also includes *tasmaniensis* and *griffini*. The genotype of *Koinga* is *Squalus whitleyi* Phillipps, with its New Zealand ally, *kirki*. There are further features of the teeth, dermal denticles, position of nostrils, etc., which distinguish the above subgenera from true *Squalus*.

Centrophorus scalpratus, McCulloch.

(Fig. 12.)

Eye (30 mm.) 4.4, snout (42) 3.1, interorbital (59) 2.2 in the head (132). Head 4.1, depth (78) nearly 7 in total length (544). Width of head before gills greater than preoral length. Snout acute. Nostrils large, transverse. Spiracles large, crescentic, less than half the large eye. No nictitating fold or membrane. Mouth little arched with deep labial grooves. Teeth acute, erect, unicuspid in upper jaw, rather like arrowheads, in several series. Teeth deflected obliquely outwards in lower jaw and with microscopic serrae. No median tooth in lower jaw. Five moderate gill-openings,

the last, which lies over pectoral base, is much deeper than the first. Chin folds present.

Body rounded, robust, covered with spaced rough tricarinate denticles which are not arranged in rows. On the snout the denticles are enlarged, with five or more converging carinae. Anal area and axils naked. Belly not flattened. No lateral keels.

Each dorsal fin preceded by a compressed spine with grooves. First dorsal spine shorter than second, but first dorsal fin larger than second. Posterior angle of pectorals notably produced. Ventrals in advance of origin of second dorsal; they are attached to the body just behind the vent on each side and their origins are nearer caudal than pectorals. Upper caudal lobe well developed, truncate; lower lobe rounded. No anal fin. No conspicuous black glandular areas. Lateral line system not very conspicuous.

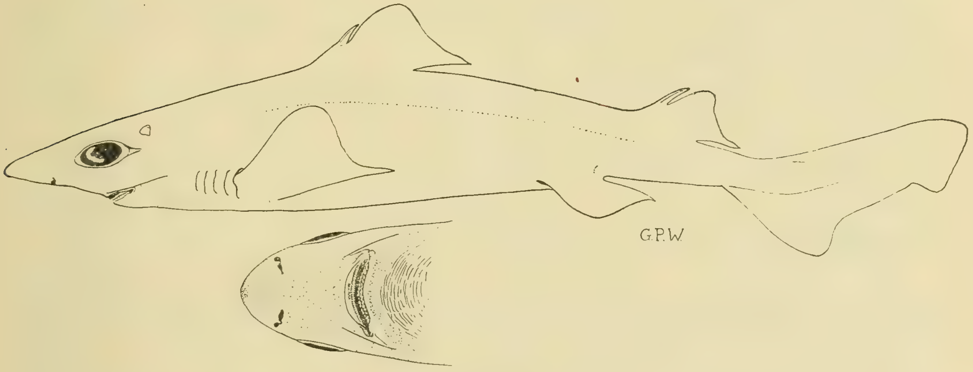


Fig. 12. *Centrophorus scalpratus* McCulloch. A female from off Gabo Island, Victoria (Austr. Mus., Regd. No. E.5533). . G. P. Whitley *del.*

General colour dark brownish grey, becoming yellower or with a vinous tinge on fins. Fin-spines blackish. Axillary areas, chin and labial folds, lips, and edges of nostrils and gills whitish. Eye greyish.

Described and figured from a female specimen (No. E. 5,533), one of a series trawled in 240 fathoms, 30 miles S.W. of Gabo Island, Victoria, by the "Endeavour" on 12th September, 1914. Another was taken in 70 fathoms, east of Babel Island, Bass Strait.

Differ from the type of *scalpratus* figured by McCulloch (Biol. Res. Endeavour, iii., 1915, p. 97, pl. xiii., figs. 2-7) from the Victorian coastline in having teeth of upper jaw erect, dermal denticles more carinate, second dorsal fin overhanging subcaudal lobe, and caudal fin about a quarter total length. These differences may be due to youth; I do not think a distinct subspecies is represented.

This species may now be added to the fauna of New South Wales, specimens trawled off our southern coasts having been received from Mr. Melbourne Ward (Austr. Mus., Regd. Nos. IA. 8,094 to 8,096).

ACANTHIDIUM MOLLERI, Whitley.

Acanthidium molleri Whitley, Rec. Austr. Mus., xx., 4, March 31, 1939, p. 264, fig. 1. East of Sydney, N.S.W.; 130 faths.

Twenty-three specimens of this species were trawled by the F.I.S. "Endeavour" in the Great Australian Bight, south and south-east from Eucla, in 130 to 450 fathoms, May, 1913. The largest is a male, twenty inches long. New record for South and Western Australia.

Family RHINOBATIDAE.

Genus RHINOBATOS Linck, 1790.

Rhinobatos Linck, Mag. neues. Physik. naturg., vi., 3, 1790, p. 32. Tautotype, *Raja rhinobatos* Linné, 1758.

Leiobatus Rafinesque, Caratt. n. gen. Sicil., 1810, p. 16. Haplotype, *Leiobatus panduratus* Raf. = *rhinobatos* Linné.

Squatinoraja Nardo, Oss. Adriat. Ittiol., 1824. Type, *S. colonna* Nardo—*fide* Jordan, Gen. Fish.

Glaucostegus Bonaparte, Icon. Faun. Ital. Introd. Pesc., 1841, p. 4. Haplotype, *Rhinobatus cemiculus* Geoffroy St. Hilaire, 1827.

Syrrhina Müller & Henle, Syst. Plagiost. (3), 1841, p. 113. Logotype, *Rhinobatus columnae* Bonaparte, 1835, selected by Jordan & Evermann, 1896.

Acroteriobatis Giltay, Ann. Soc. Roy. Belg., lix., 1928, p. 26. Logotype, *Rhinobatus (Syrrhina) annulatus* Müller & Henle, 1841, by present designation.

Modern authors sometimes use the names *Rhinobatos* and *Leiobatus* for two distinct subgenera, notwithstanding that the type of the latter is regarded by them as an absolute synonym of that of the former. Norman (Proc. Zool. Soc. Lond., 1926, p. 945) gave a synopsis of the species, which may be grouped into subgenera as follows:—

Scobatus, nov., for species 1 and 2, with *Rhinobatus granulatus* Blainville, 1816, as orthotype.

Platipornax, nov. for sp. 3, *thouiniana* = *Raja thouin* Anon., 1798.

Glaucostegus for species 4 to 7.

Rhinobatos (syn. *Leiobatus, Squatinoraja,* and *Syrrhina*) for Nos. 8 to 14.

Acroteriobatus for species 15 to 19.

More names may later be found necessary for some of the American species, Nos. 20 to 27. I have been unable to find a logotype-designation for *Acroteriobatus,* so select *annulatus* for the purpose.

RHINOBATOS (PLATIPORNAX) THOUIN (Anon.).

Raja thouin Anon., Allgemeine Literatur-Zeitung, iii., 287, Sept. 24, 1798, p. 677, *et ibid.,* Sept. 25, 1798, p. 685, pl. i., figs. 3-4. Latinization of Lacépède's vernacular. No locality.

This species, as *Rhinobatos thouiniana,* appears on Australian lists, but the type may have come from Surinam or South Africa, and local records refer to different species. The name of this species should be erased from our fauna.

RHINOBATOS BATILLUM, *sp. nov.*

(Fig. 13.)

Rhinobatos armatus, thouini, and *halavi* of Australian authors.

The figure on the next page represents an immature male specimen from Sharks Bay, Western Australia, where I obtained it in July, 1939, the species being common in sandy shallows there and easily approached. It comes down to *armatus* in Norman's key (Proc. Zool. Soc. Lond., 1926, iv., pp. 941 & 952, fig. 6) but differs from his description of that Indian species in proportions, having the preorbital length 4 times the distance between the spiracles instead of 3 to 3-1/5th, and preoral length 2½ instead of 3 times width of mouth. The eye plus spiracle is subequal to the distance between the spiracles. The space between the origins of the dorsal fins is equal to distance between origin of first dorsal and base of ventrals.

The nostrils are oblique and very long. Internarial width more than half narial diameter. Spiracle with a large outer and a small inner fold. Flat coarse denticles around eyes and along back, particularly enlarged along median line and scapulars. Anterior edges of dorsal fins similarly armed. Total length 42 inches. Length of first dorsal nearly 4½ ins.

Colour olive-greenish above. Snout gelatinous-looking. Fins yellower. Ventral surface whitish.

The stomach contained several well-digested prawns and the head of a small flathead (fam. Platycephalidae).

As *R. armatus,* this ray has been caught in shallow waters around the north of Australia from Sharks Bay in the West, across the Northern Territory down to the Capricorn Group in Queensland. Ogilby remarks of it, "freely entering and even permanently residing and breeding in fresh water". A common size in Queensland is about two feet, but it grows to between 6 and 7 feet. A 42½ inch male which I collected at North-west Islet, Queensland, on November 27, 1925, agrees remarkably with the Sharks Bay specimen in measurements.

RHYNCHOBATUS DJIDDENSIS AUSTRALIAE, *subsp. nov.*

(Fig. 14.)

Australian specimens of the White-spotted Ray differ in shape and colour-markings from Indian and Red Sea illustrations, being especially wider towards the root of the tail. The type of the new subspecies is a fine specimen, trawled off the Manning River, New South Wales. A young example was sandy-brown above, the sides and pectorals with scattered white ocelli; a round black spot posteriorly on the scapular region; lower surface white, clouded with rufous; snout with transverse darker area and black spots anteriorly.

Family RAJIDAE.

Genus RAJA Linné, 1758.

In its broadest sense, this genus includes all the Skates of the world, but modern studies, especially following Leigh-Sharpe's analyses of the characters of the claspers and pelvic girdles, suggest that about twenty genera and subgenera should be distinguished in place of the original *Raja*. There is no lack of names for most of these: the trouble lies rather in

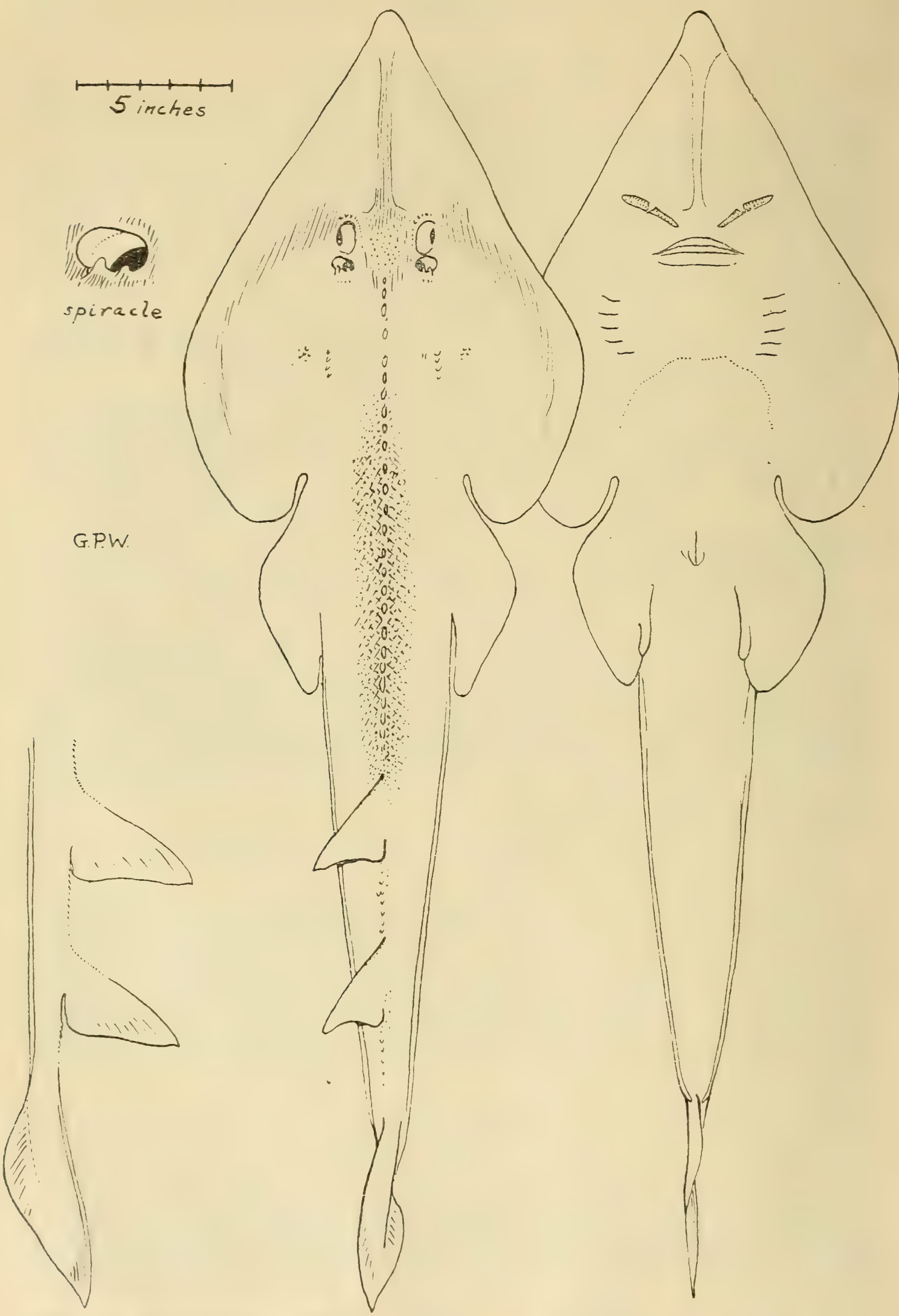


Fig. 13. *Rhinobatos batillum* Whitley. A specimen from Sharks Bay, Western Australia. .. .. G. P. Whitley *del.*

determining earliest available names and genotype-designations. In the main, these "synonyms" have been tabulated by Fowler (Bull. Amer. Mus. Nat. Hist., lxx., 1, 1936, p. 104), but I would add to his list *Eleutherocephalus* Agassiz (Nomencl. Zool., 1846, Index Univ., pp. 71 & 136, an emendation for *Cephaleutherus* Rafinesque), *Peroptera* and *Perioptera* Gistel (Nat. Thierr. höh. Schulen, 1848, p. x.), all based on abnormal skates. The name *Propleygia* was published in Gray's List Specimens Fish. Brit. Mus., i., Chondropt., 1851, pp. 83, 105 & 153, and seems to be an error for *Propterygia* Otto.

The genus *Raja* has been regarded as a large one, embracing so many species that sometimes the same specific name has been used for more than one species. To avoid future use of names which are preoccupied, I offer here an alphabetical list of all the specific names of *Raja* spp. (sensu

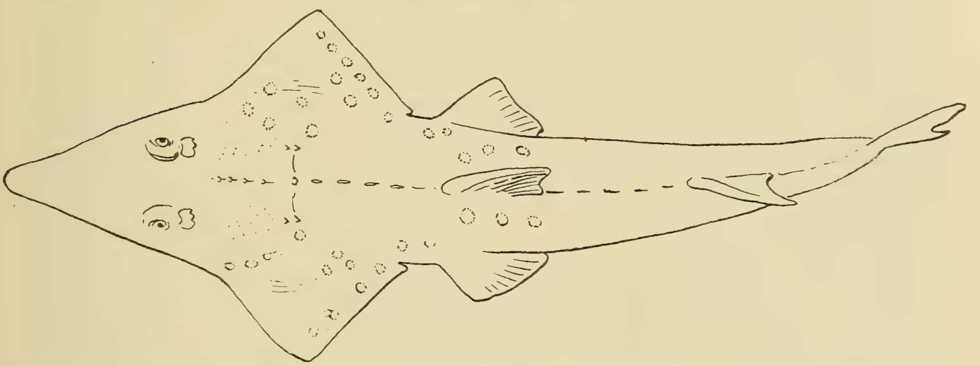


Fig. 14. *Rhynchobatus djiddensis australiae* Whitley. Holotype of subspecies, a large specimen from off Manning River, New South Wales. . . . . G. P. Whitley *del.*

latissimo) known to me: ***abredonensis, abyssicola, ackleyi, aculeata, acus,*** *acutidens, africana, agassizi, aguja, ajereba, alata, alba, albolinea, albomaculata, aleutica, altavela, americana, andamanica, annandalei, antiqua, apteronota, aquila, arctowskii, armata, arnak, ascanii, aspera, asperrima, asterias, atra, atriventralis, aurita, australis, badia, banksiana, baracola, barbata, barnardi, bathyphila, batis, bavosa, bicolor*, Shaw, 1804, *bicolor*, Risso, 1826, preocc. (= *alba*), *binocularis, binoculata, biocularis, birostris, bispecularis, bispinosa, blanda, bonaespeiensis, bonasus, borea, borussica, brachyura* Lafont, 1871, *brachyura* Gunther, 1880, preocc. = *brachyurops, bramanta, brasiliensis, brevicaudata, burgeri, capensis* Gmelin, 1789, *capensis* Müller & Henle, 1841, preocc. (= *bonaespeiensis*), *castelnaui, caudaspinosa, cemiculus, cent(r)oura, cephaloptera, cerva* (sp. nov., infra), *chagrinea, chantenay, chilensis* Gay, 1848, *chilensis* Steindachner, 1898, preocc. (= *steindachneri*), *chinensis, ciodera, circularis, clavata, columbus, columnae, cooperi, cornuta, crabuda, cruciata, cuculus, cuvierana, cuvieri(i), cuvieriana, cyclophora, dentata, desmaresti, diabolus, diabolus marinus, diaphanes, dipterygia, djiddensis, doello-juradoi, durbanensis, dux, eatonii, echinorhyncha, edentula, eglanteria, episcopus, equatorialis, erinacea, estrellada, extenta, fabroniana, falsavela, fasciata* Shaw [a *Myliobatis*], *fasciata* Bleeker, 1855 [An *Aptychotrema*], *fasciata* Müller & Henle [= *Trygonorrhina*], *fenestrata, fimbriata, flagellum, flavirostris,*

flossada, fluviatilis, freminvillei, fullae, fullonica, fusca, fyllae, gaimardi, gallardoi, gallica, garmani, sp. nov. (for *ornata* Garman, 1881, preocc.), *gentili, georgiana, gesneri, giorna, giorniana, gotoi, granulata, granulosa, griseocauda, guttata* Bloch & Schneider, 1801 [a *Dasyatis*], *guttata* Shaw, 1804, preocc. [a *Stoasodon*], *halavi, hispanica, hollandi, horraeka, hyperborea, hyposticta, imbricata, inermis, ingolfiana, inornata, intermedia, interrupta, isotrachys, jamaicensis, japonica, joenia, johannis-davisi, jojenia, jordani, jussieui, karagea, katsukii, kenojei, kincaidii, kujiensis, kunsua, laevis, latastei, leiobatos, lemprieri, leopardus, leucobatos, levis, ligonifer, lima, lineata, lintea, lipacantha, lymma, lymna, lymnia, lymnoea, machuelo, macloviana, maclura, macrocephala, macrorhynchus, maculata* Shaw, 1804, *maculata* Montague, 1818, preocc. (= *montagui* = *oculata*), *maculata* Jenyns, 1835 (= *miraletus*), *madarensis, maderensis, magellanica, mamillidens, manatia, marginata* Lacépède, 1803, *marginata* Risso, 1826, preocc. (= *alba*), *maroccana, marplatensis, meerdervoorti, megarhynchus, melitensis, meta, microocellata, microps, microtrachys, micrura, minor, mira, miraletus, mobular, molaridens, monstrosa, montagui, montereyensis, morula, mosaica, motoro, mucosa, mucosissima, mucronata, mula, multispinis, muricata, murrayi, mus marinus, naevus, narce, narcus, narinari, nasuta, nazinari* & *neruari* Van Hasselt, 1823 (= *narinari*), *nidarosiensis, niehofi, nigra, nitida, noctula, obtusa* Klunzinger, 1871, *obtusa* Gill & Townsend, 1897, preocc. (= *rosispinis*), *ocellata, ocellifera, oculata, ogilbyi,* sp. nov. (infra), *ommes-scherit, omirnovi, orbicularis, ornata,* Agassiz, 1843, *ornata* Garman, 1881, preocc. (= *garmani,* sp. nov.), *osbeckii, oxyptera, oxyrinchus, parcomaculata, parmifera, parvidens, pastinaca, pennanti, pentagona, percellens, philipi, picta* Lacépède, 1802, *picta* Ribeiro, 1904, preocc. (= *ribeiroi*), *pigara, platana, platypterus, plutonia, poecilura, polyommata, polyophthalmus, polystigma, pontica, porosa, powelli, primarmata, pulchra, punctata, quadriloba, quadrimaculata, quatuoroculus, quinqueaculeata, quinquemaculata, radiata, radula, rapensis, reversa, rhina, rhinobates* or *rhinobatos, rhizacanthus, rhomboidalis, ribeiroi, rosispinis, rostellata, rostrata* Shaw & Nodder, 1794, *rostrata* Lacépède, 1802, preocc., *rostrata* Risso, 1810, preocc. (= *oxyrhinchus*), *rostrata* Taylor, 1855 [= *Bathytoshia brevicaudata*], *rostrata* Castelnau, 1873 (= *whitleyi*), "*ruber* Bloch" Garman, 1913 [error for *rubus*], *rubra* Swainson, 1838, *rubus, salviani, sancur, say, scabra* Linné, 1764, *scabra* Latreille, 1804, preocc. (= *fullonica*), *scabra* Ogilby, 1888, preocc. (= *whitleyi*), *scabrata, scaphiops, scherit, schlegeli, schonkie, schoukia, schou(s)kie, schultzii, scobina, senta, sephen, siamensis, sibogae, similis, sinensis, sloanii, smirnovi, smithii, speculum, spinacidermis, spinicauda, spinosa, spiralis, squatinoraja, stabuliforis, steindachneri, stellaris, stellatus, stellulata, sueta, tajara, tengu, texana, thouin(i), thouiniana, timlei, tobae,* Tanaka, 1916, *tobae* Tanaka, 1927, preocc. (= *karagea*), *torpedo, trachura, trigonoides, tuberculata* Bonaterre, 1788, *tuberculata* Lacépède, 1802, preocc. [= *Dasyatus guttatus* (*Bl. Schn.*)], *uarnak, undulata, vespertilio, violacea, virgata, vomer, vulgaris, waitii, whitfieldi, whitleyi.*

RAJA GARMANI, *sp. nov.*

This new name is proposed for *Raja ornata* Garman (Bull. Mus. Comp. Zool. Harvard, viii., 1881, p. 234), preoccupied by *Raia ornata* Agassiz (Poiss. Fossiles, iii., 1843, p. 372).

RAJA CERVA, *sp. nov.*

(Plate xx., fig. 1.)

"White-spotted Skate, *Raja* sp." Whitley, Austr. Mus. Mag., vi., 11, Nov. 8, 1938, p. 380, fig. 19 (egg-case from Bass Strait).

Disc (78 mm. wide), much wider than long, and about two-thirds of the total length (118). Anterior margins undulated and slightly asymmetrical, the outer angles rounded. Vent nearer tip of snout than end of tail. Snout obtusely pointed, its length (15 mm.) less than one-fifth width of disc. Teeth minute, spaced. Eye (7) equal to interorbital space (7) and less than half snout. Internasal width (10) equal to width of mouth (10), and 1.8 in preoral length (18). Spiracle small, slit-like, behind and close to eye.

Surfaces mainly smooth. No bucklers. Two strongly diverging spines before each eye and one outwardly directed postocular spine. One large median nuchal spine, a row of twelve spines along the top of the tail, and another spine between dorsal fins. Tail depressed, with lateral folds which cease before the pointed tip. Two separate rounded dorsal fins; behind the second is a skinny crest extending to tip of tail.

Colour in formalin, varying shades of brown from light tan to dark brown on the dorsal surfaces. Disc with scattered white or yellowish nebulous spots above. Tail with a few indistinct dark brown cross bars, darkest where they extend on to dorsal fins. Edges of disc and tip of tail buff. Eyes bluish. Ventral surfaces pale yellowish, somewhat duskier towards margins of fins. No pigmented pores on lower surface of disc.

Described and figured from the holotype of the species, a young male, 78 mm. wide or about 4-5/8 inches in total length. Austr. Mus., Regd. No. E. 4,970.

Locality.—25 miles N.E. of Babel Island, Bass Strait, north of Tasmania; 70 to 100 fathoms (F.I.V. "Endeavour", April 4, 1914).

This species differs from the Common Skate, *Raja australis* Macleay, in having a less produced snout, in its proportions, spinulation and colouring. There are three rows of spines in the grown female instead of five (one in the male), and the back is distinctly white-spotted. The late A. R. McCulloch, when aboard the F.I.V. "Endeavour", found the species not uncommon in the trawl off Babel Island, Bass Strait, and preserved several small specimens. He noted that large examples develop large spines over the anterior portions of the pectoral fins.

Amongst the paratypes in the "Endeavour" collection, two (Nos. E. 4898-4899) were taken with the holotype, whilst one (E. 5491) was trawled south of Gabo Island, Victoria; 200 fathoms, October 6, 1914. The latter is about the same size as the holotype, but has no white spots on back and the fin-margins are duskier. The species thus ranges from Victoria to north of Tasmania.

Egg-case.—The egg of this species is of the usual quadrangular *Raja* type, one (No. E. 4973) is 2¾ by 1½ inches and invested with pale greenish, slimy fibres. This was figured in the Australian Museum Magazine, vi., 1938, p. 380, fig. 19.

RAJA WHITLEYI Iredale.

? *Raja dentata* Klunzinger, Arch. Naturg., xxxviii., 1, 1872, p. 46. Port Phillip, Victoria. Type in Württembergische Naturaliensammlung,

Stuttgart, seen. *Id.* Klunzinger, Sitzb. Akad. Wiss. Wien., lxxx., 1, 1879, p. 429, and of Australian lists. See also p. 251, fig. 16 of this paper.

Raja oxyrhynchus Castelnau, Proc. Zool. Acclim. Soc. Vict., i., July 15, 1872, p. 224. Melbourne market. Not *Raja oxyrinchus* Linné, Syst. Nat., ed. 10, 1758, p. 231, from Europe.

Raya rostrata Castelnau, Internat. Exhib. Essays, 1872-1873, No. 5 (before May), 1873, p. 17. Melbourne, Victoria. New name for *R. oxyrhynchus* Cast., non Linné, but thrice preoccupied by *Raja rostrata* Shaw & Nodder, Nat. Miscell., v., 1794, pl. clxxiii., from Botany Bay; *Raja rostrata* Lacépède, Hist. Nat. Poiss., iv., 1802, p. 669, from France; *Raia rostrata* Risso, Hist. Nat. Eur. Merid., iii., 1826, p. 156, from the Mediterranean. Not *Raia rostrata* Taylor, Te Ika a Maui, ed. 1, 1855, p. 412, from New Zealand [= *Bathytoshia brevicaudata* (*Hutton*)].

Raya rostrata Castelnau, Proc. Zool. Acclim. Soc. Vict., ii., May, 1873, p. 57.

Raja rostrata Macleay, Proc. Linn. Soc. N.S.W., vi., Sept. 12, 1881, p. 376; Descr. Cat. Austr. Fish., ii., 1881, p. 312.

Raia scabra Ogilby, Cat. Fish. Austr. Mus., i., 1888, p. 17. Manly, N.S.W. and Port Phillip, Victoria (latter designated type-loc.). New name for *Raia rostrata* Castelnau, preocc., but itself preocc. by *Raja scabra* Linné, Mus. Adolph. Frid., ii., 1764, p. 52, from the Mediterranean, and by *Raja scabra* Latreille, Nouv. Dict. Hist. Nat., ed. 1, xxiv., 1804, p. 72, footnote, from Britain.

Raia scabra Waite, Mem. N.S.W. Nat. Club, ii., 1904, p. 10. *Id.* Engelhardt, Abh. K. Akad. Wiss. Bayern, iv. (3), 1913, p. 103.

Raja scabra Lucas, Proc. Roy. Soc. Vict. (2), ii., 1890, p. 46. *Id.* Stead, Ed. Fish. N.S.W., 1908, p. 119. *Id.* Ogilby, Mem. Qld. Mus., iii., 1915, p. 133. *Id.* McCulloch, Austr. Zool., i., 1919, p. 225; and Austr. Zool. Handbk., i., May 16, 1922, p. 11.

Raia nasuta Garman, Mem. Mus. Comp. Zool. Harv., xxxvi., 1913, p. 366. Synonymy. Not *Raja nasuta* Müller & Henle, Syst. Plagiost. (3), 1841, p. 150, *ex* Banks, MS., from "Südsee", i.e., Totaeranue, New Zealand.

? *Raja scabra* Whitley, Austr. Mus. Mag., vi., 1938, p. 381, figs. 22-24 (egg-cases ascribed to the Great Skate, though Castelnau described eggs as "of a silky green").

Raja whitleyi Iredale, Austr. Zool., ix., 2, Nov. 30, 1938, p. 169. Port Phillip, Victoria. New name for *Raja scabra* Ogilby, preocc. by Linné.

Because of its gigantic size, there is no good specimen of this skate in any Museum. If *Raja dentata* be the young of this species, then its name will take precedence; this seems unlikely, however, especially as no intermediate specimens have been obtained. In 1873, Count F. de Castelnau (International Exhibition Essays, 1872-1873, No. 5, Notes of the Edible Fishes of Victoria, p. 17) mentioned that "several sorts of Rays are brought to the market; the two most common are the *Raya Lemprieri,* of which the male has two or three series of crooked spines on the pectoral, and a sort I had taken for the *Raya Oxyrhynchus* of Europe, but which seems to be different, and that I will call *Raya rostrata*". Ogilby showed that *rostrata* was preoccupied and renamed it *scabra,* but Iredale found a prior *scabra* which invalidated Ogilby's name and called it *whitleyi,* designating Port Phillip as type-locality. The Great Skate of New South Wales (Ogilby's Manly specimen) appears distinct again and is accordingly described as *Raja ogilbyi,* sp. nov.

RAJA (SPINIRAJA) OGILBYI, *subg. et sp. nov.*

(Fig. 15.)

Raia rostrata Ogilby, Town & Country Journal (Sydney), Sept. 24, 1887, p. 654, fig. —.

Raia scabra Ogilby, Cat. Fish. Austr. Mus., i., Palaeichth., 1888, p. 17. Manly specimen only. Not the Port Phillip type which is *whitleyi* Iredale.

The large skin catalogued by Ogilby is still in the Australian Museum though its tail is missing. It has the following characters.

Snout acute. Anterior margin bisinuate. Width of disc (52 inches) greater than its length (38). Interorbital broad and sunken. Eyes small. Spiracles large. Ventrals not much excavated. Specimen is female, so no claspers. Whole of top and bottom of disc with spaced spines making the skin very rough; one or two enlarged spines on middle of back between ventral fins; no enlarged spines around eyes. The vent was probably nearer the end of tail than tip of snout. No pigmented pores below disc.

Mouth broad with 46 rows of teeth in upper jaw and 40 in lower, worn mesially. The two-rooted teeth are somewhat rhombic in outline, with a pyriform crest towards which converge several ill-defined ridges. Nasoral fold with a pointed lobe just behind nostril. Nostril flaps not large.

Colour now dark reddish brown above, lighter below.

Described and figured from a specimen (Austr. Mus. Regd. No. I. 1346), said to have been 6 feet long and over 4½ feet wide.

Locality.—Manly, New South Wales; purchased for 25/- in July, 1887.

This old skin is the only specimen I have of the local Great Skate. It is possible that *R. rostrata* Cast., preocc. = *R. scabra* Ogilby, preocc. = *R. whitleyi* Iredale, from Port Phillip, Victoria, is the same species as *R. dentata* Klunzinger. Further specimens are, however, required to study the changes with growth before large specimens such as this one can be identified with the Melbourne species. Ogilby's Manly example differs from *dentata* in proportions of eyes, interorbital, and snout, in the lobed nasoral groove, and in minor respects concerning the spinulation of the body and the form of the teeth. These may be due to age, or they may indicate specific separation.

The new subgeneric name *Spiniraja* is proposed for *Raja ogilbyi*, since it differs from true *Raja* in being very spiny above and below.

RAJA DENTATA Klunzinger.

(Fig. 16.)

Through the kindness of Dr. M. Rauther, I have been able to examine the types of this species, preserved in the Württembergische Naturalien-sammlung, Stuttgart, Germany. A figure of the lectotype is given here.

There are two types in Stuttgart labelled "Port Philipp, Australien, v., Müller, 1869-1871". I select the larger as lectotype. The specimen, a female, is slightly shrivelled, measuring approximately 285 mm. from snout to vent and about 245 from vent to end of tail. Width of disc, 330 mm.; snout to pectoral margin about 305. Teeth quincunx, with pointed crowns. Numerous denticles almost embedded in integument, a median row of larger denticles, about 40 before root of tail (the second specimen is even more

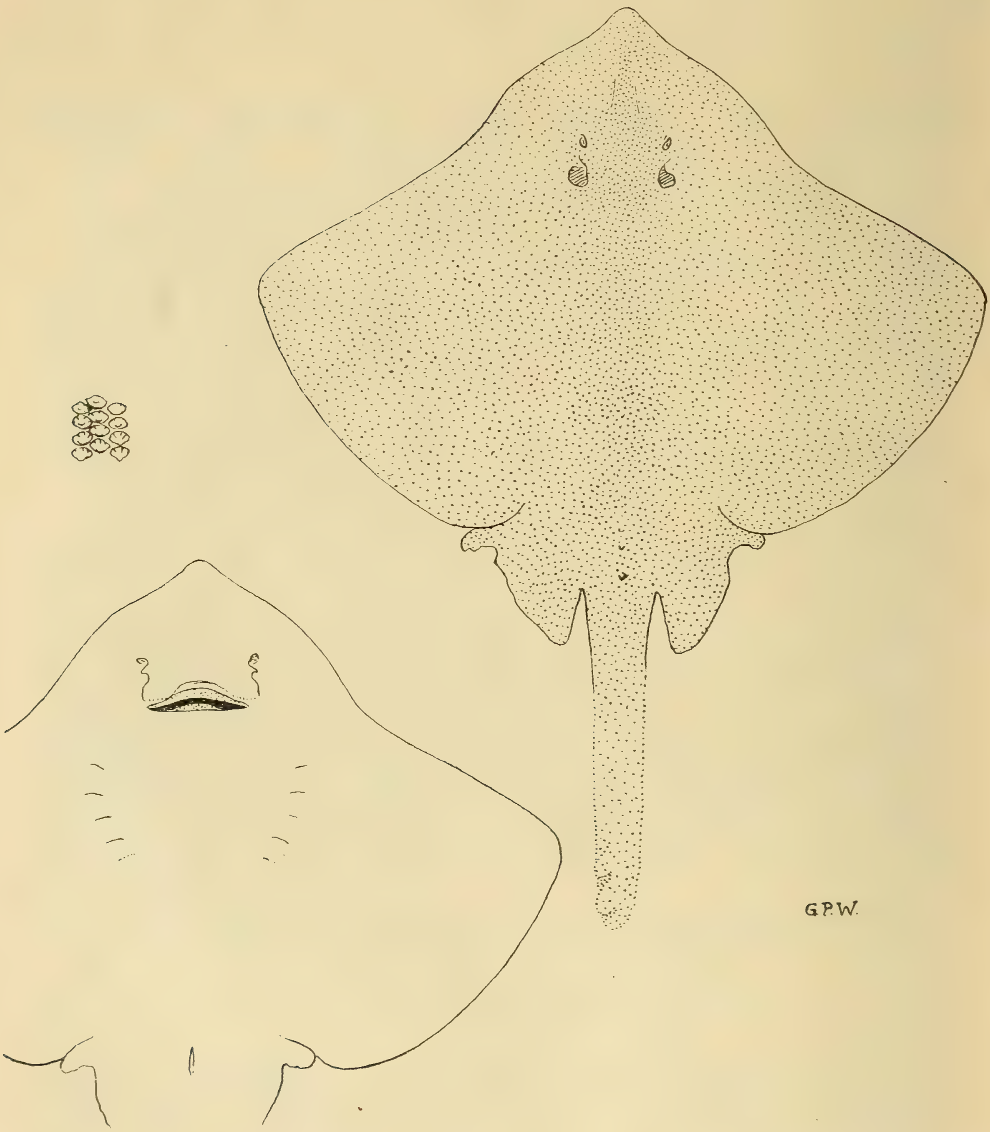


Fig. 15. *Raja* (*Spiniraja*) *ogilbyi* Whitley. Holotype from Manly, New South Wales (Austr. Mus., Regd. No. I.1346). Tail reconstructed. Inset shows teeth .. .. G. P. Whitley *del.*

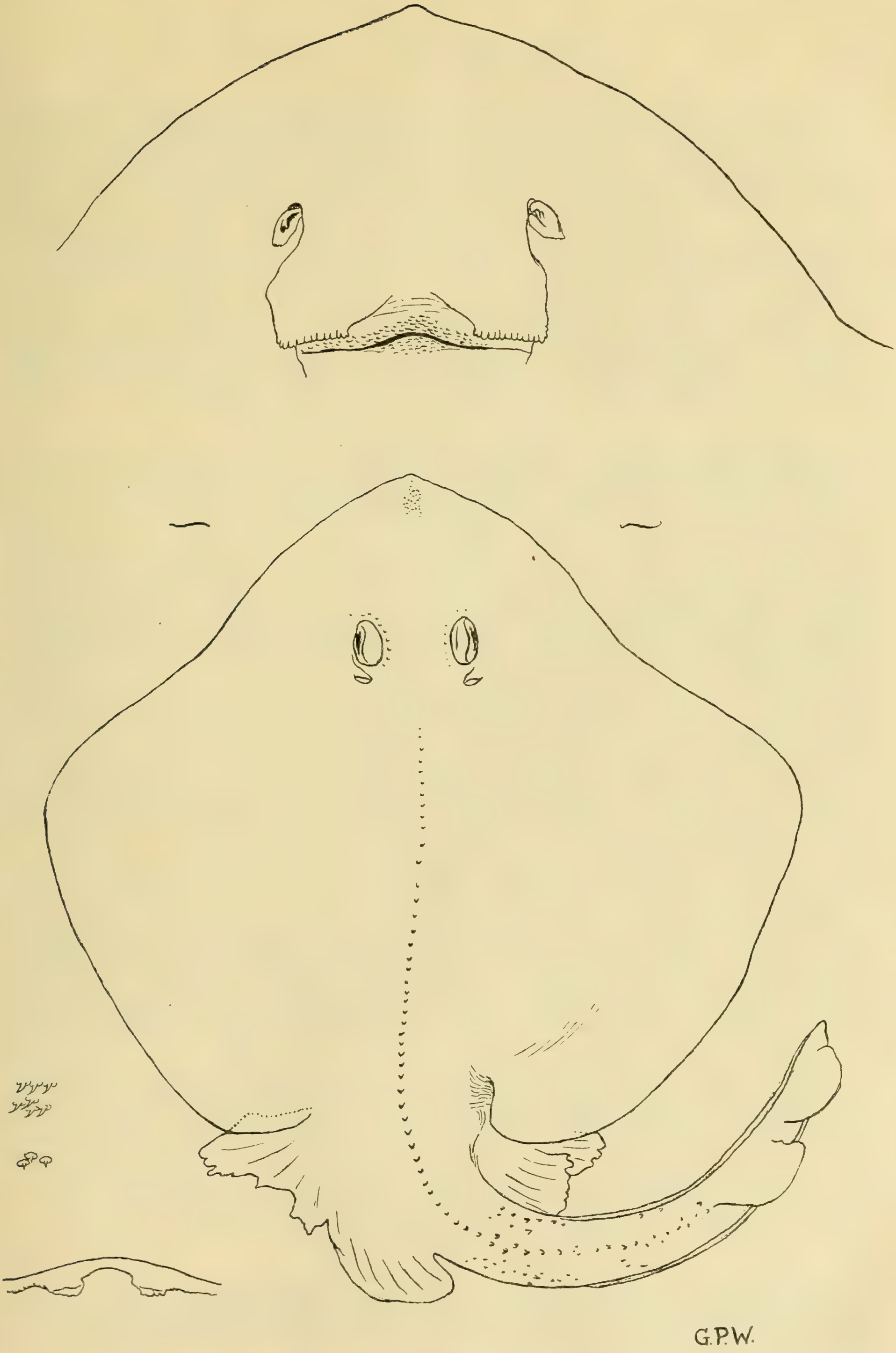


Fig. 16. *Raja dentata* Klunzinger. Lectotype from Port Phillip, Victoria. Lower left: Teeth, velum maxillare, and buccal processes. (Württemb. Nat. Mus., Stuttgart, No. 1658, 1816). . G. P. Whitley *del.*

spiny, having denticles between eyes, on snout, and sides, and with pores on ventral surface of head. A fold on each side of tail reaching to end. Brown with a few indistinct darker blotches. Velum maxillare crinkled, emarginate mesially; about five short buccal processes, but these soft parts may have shrunken in preservative.

In 1879, Klunzinger recorded the male of this species. His specimen has sharp hook-pointed teeth. The spines are sharper than those of the female and there are only about 4 by the eye instead of about a dozen. Two rows of spines form the tenacula.

Another Melbourne specimen is in the Australian Museum (Regd. No. I. 12050); it agrees well with the type and has the following characters: 38 rows of teeth, spiny above and below disc, vent slightly nearer tip of tail than end of snout and no pigmented pores on lower surface.

ZEARAJA, *gen. nov.*

Orthotype, *Raja nasuta* Müller & Henle, 1841, from New Zealand.

ZEARAJA NASUTA (Müller & Henle).

(Plate xxi.)

This species has a produced snout, "shouldered" pectorals, surface of disc rough above and with blackish pits below. A median row of strong spines along tail, one on middle of back, and a few near the eyes. Here figured from a young example nearly 11 inches wide from the Portobello Marine Hatchery, New Zealand (Austr. Mus., No. IA. 7087).

RIORAJA, *gen. nov.*

Orthotype, *Uraptera agassizi* Müller & Henle = *Rioraja agassizi.*

This new name is devised to replace *Uraptera* Müller & Henle (Ber. Verh. k. pr. Akad. Wiss., 1837, p. 117; Mag. Nat. Hist. (Charlesworth) (n.s.), ii., 1837 (early 1838), p. 90, and Plagiost., 1841, p. 155), which is clearly preoccupied by *Uraptera* Billberg, 1820, a genus of Lepidoptera.

PAVORAJA, *gen. nov.*

Orthotype, *Raja nitida* Gunther = *Pavoraja nitida.*

Snout produced into a small fine point. Eyes large. Disc heart-shaped in outline, the pectorals being rounded, not "shouldered". Upper parts generally with minute asperities. A few curved spines at eyes, one in middle of back, and a median row of spines before tail. Lower surface smooth. Coloration ornate, with small ocelli. Size small (maximum length 13½ inches).

Besides the type-species, which is trawled in 70 to 90 fathoms in southern New South Wales, Victoria and across Bass Strait to Tasmania, there is the northern species, *Pavoraja polyommata* (Ogilby) from Queensland.

Other new generic names will probably be found necessary for certain foreign skates, but these need not be proposed here.

PAVORAJA POLYOMMATA (Ogilby).

(Plate xxii., fig. 1.)

In 1910, Ogilby read a paper "On Some New Fishes from the Queensland Coast" before the Royal Society of Queensland. Reprints of the paper were distributed, but it was not published in the official proceedings of the

Society; details have been given by McCulloch (Biol. Res. Endeavour, ii., 1914, p. 79). The only elasmobranch described in Ogilby's paper was *Raja polyommata,* but the name must be regarded as a *nomen nudum* until defined in a recognized publication. A short description was given by Ogilby in Mem. Qld. Mus., v., 1916, pp. 86 & 95, so the name can be regarded as valid from July 10, 1916.

A figure is here given for the first time, prepared by Miss Joyce Allan from one of Ogilby's co-types, a female, 8½ inches long by 5½ wide.

Locality.—38 miles N.E. of North Reef, off Rockhampton, Queensland; trawled in 75 fathoms, shell and mud bottom, by the F.I.S. "Endeavour" in 1910. Specimen now designated lectotype, Austr. Mus., Regd. No. I. 10904.

Irolita waitii (McCulloch).

In a popular article on the eggs of Australian Sharks and Rays (Austr. Mus. Mag., vi., 11, 1938, pp. 372-382, figs. 1-28), I tentatively identified a Victorian egg as that of the Round Ray, *Irolita waitii,* although this species had not then been recorded from Victoria. The egg is very different from that of the allied *Psammobatis* described in the Proceedings of the U.S. Nat. Mus., Vol. l. (fifty), 1916, pp. 404 & 421.

However, in the "Endeavour" collection there are specimens of the Round Ray trawled on the eastern edge of Bass Strait between Gabo and Flinders Islands, outside the 100 fathom line (Regd. No. E.|4603), so that the inclusion of Victoria in the range of this species is correct whether the egg be correctly ascribed to it or not. The "Endeavour" also trawled this species in the Great Australian Bight, west from the meridian of Eucla, in 70 to 120 fathoms.

Family Urogymnidae, *nov.*

Urogymnus asperrimus solanderi, *subsp. nov.*

(Fig. 17.)

A large kind of ray was caught by Cook's men in 1770 off the Endeavour River, now in North Queensland. I found a manuscript latin description of it amongst Solander's MSS in the British Museum (Natural History). Solander called it *"Raja radula"* but that name is not available for publication now because it has already been used for a European skate (by Delaroche in 1809). Solander's description appears to fit the Thorny Ray (*Urogymnus*), to which I now give a new subspecific name to distinguish it from the Bombay type of the species. Mr. H. A. Longman has lent me the teeth, velum maxillare, and buccal processes of the holotype of my new subspecies (Qld. Mus., Regd. No. I. 13/1112), a specimen from Darnley Island, Queensland, collected by J. Tosh and here figured. I have no complete Australian specimen, only an expanse of skin from the Gilbert or Line Islands in the Australian Museum, so have modified Day's figure in the *Fishes of India* for purposes of illustration.

The following is Solander's MS. description:—

"Corpus supra glaucum undique tuberculis acutis asperatum; subtus laeve, albidum.

Cauda brevis (1-pedalis) angusta, inspinis, sed forte olim mutilata, teres, undique tuberculis aspera. Rostrum obtusiusculum. Penes latiusculi, cauda triplo breviores. Dentes plani, truncati, mutici, imbricati.

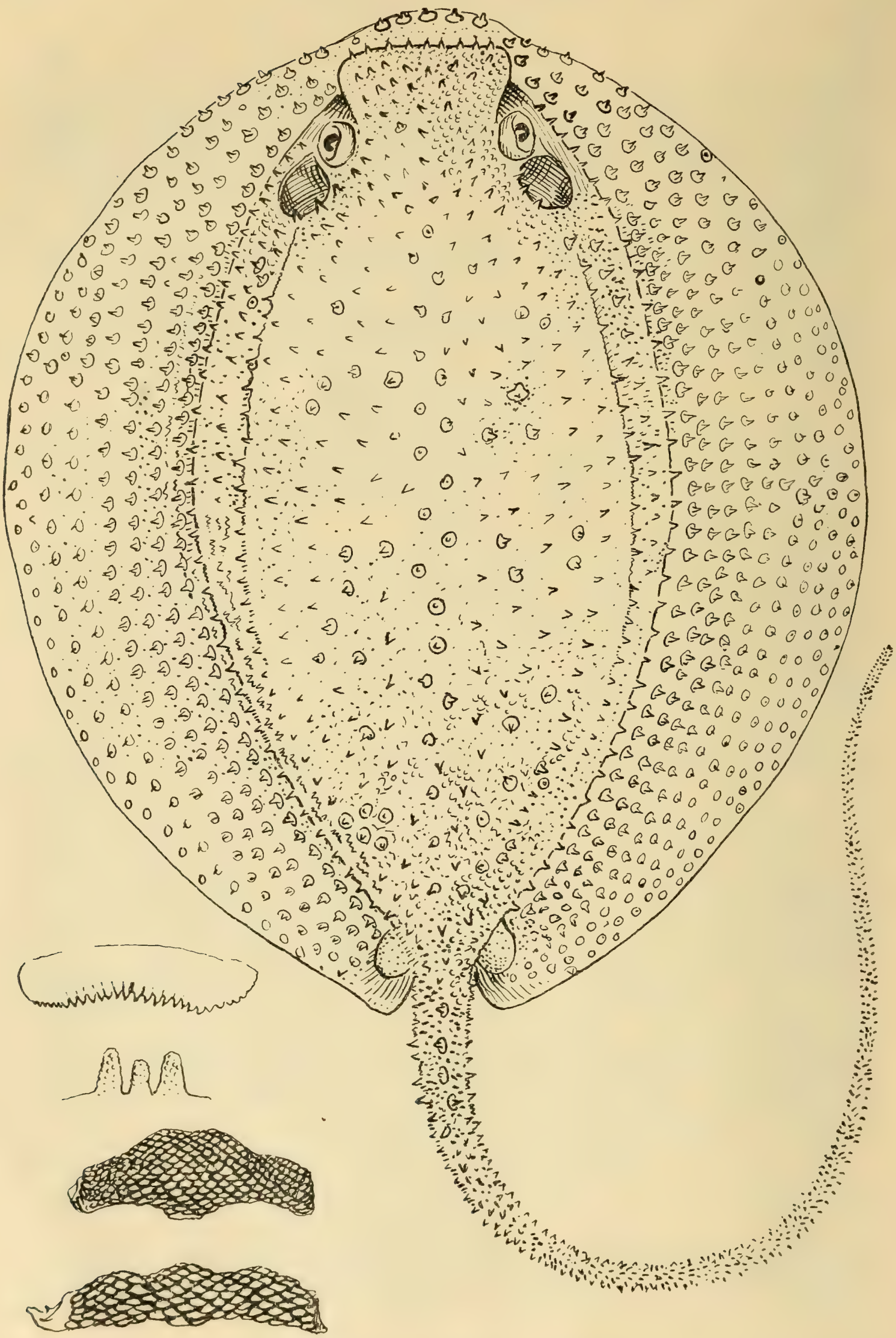


Fig. 17. *Urogymnus asperrimus* (Bloch & Schneider). Whole animal, modified from Day, *Fishes of India,* and teeth, velum maxillare, and buccal processes of subspecies *solanderi* (Qld. Mus., Regd. No. I.1112) from Darnley Id., Queensland.

Raja corpore supra undique tuberculis acutis scabro, subtus laevi, dentibus planis, imbricatis, truncatis.

Habitat in Oceano prope Endeavour River Novae Hollandiae. Pondus 110 Librarum."

Family UROLOPHIDAE, *nov.*

UROLOPHUS (TRYGONOPTERA) MUCOSUS, *sp. nov.*

(Plate xx., fig. 2.)

Breadth of disc (224 mm.) greater than its length (205), and subequal to length from snout to end of ventral fins (223).

Tail measured from middle of vent (175), 1.08 in length from middle of vent to tip of snout (190), but more than its distance from mouth (147).

Eye pupil (10), 3.7 in interocular space (37) which is greater than minimum interspiracular space (35), 1.2 in preocular portion of head (47).

Internasal width (17), 2.6, width of mouth (18) 2.5 in preoral length (45).

Front lobe not notably angular or separated from rest of disc. Anterior pectoral margins sinuous, outer angles rounded; postero-lateral margins a little convex, their junction with the inner margins rounded.

Eyes prominent, fairly large, about half interorbital.

Spiracles large, lunate, without angular projections.

Nostril flap large, extending back to level of mouth. Internasal valve plicate, with a median sulcus and long-fringed frenum. Labial folds forming pockets behind mouth. Teeth in quincunx arrangement and with blunt elevated crowns (at least in the male). Velum maxillare not markedly papillate or fringed. A few spaced simple buccal processes. Chin plicate.

Five gill-slits, body and fins as usual in *Urolophus,* the back extremely slimy. Ear-openings, lateral line, sensory and ampullary canals inconspicuous externally.

Tail depressed, without lateral folds, its width (20 mm.) between the ventral fins is more than width of mouth, and its length, from middle of vent, is less than its distance from the snout. Sting (42 mm. long) overlies a rudimentary second one, and is inserted on anterior half of tail. No dorsal fin. Claspers 37 mm. long; abdominal pores minute. Caudal fin long and narrow, its depth (11 mm.) much less than internarial width. The caudal fin originates below the proximal part of the sting on the dorsal surface and extends ventrally as a ridge reaching below anterior part of sting.

Colour (after 17 years in alcohol) fairly uniform greyish to greyish-brown above, becoming blackish on caudal fin. Under surfaces yellowish with smoky brown margins to disc and ventral fins, also some dark blotches along middle of tail.

Described and figured from the male holotype, the larger of two specimens 5 to 9 inches wide, or 369 mm. in total length (a little over 14 inches).

Locality.—Albany, King George's Sound, Western Australia; November 19, 1921. Collected by Messrs. E. Le G. Troughton, H. S. Grant and J. H. Wright. Austr. Mus., Regd. No. IA. 670 (holotype) and 671 (paratype).

Affinities.—Distinguished from all its Australian congeners by its proportions and coloration, this new species is nearest *testaceus,* from which it

differs in the proportions of the snout, nostril, and mouth areas, in having more lobes on the frenum, and in lacking the projecting angular inner margin of spiracle.

It is of historic interest to record that, amongst the drawings of fishes from King George's Sound made by Deputy Assistant Commissary General J. Neill in the 1840's and now in the British Museum (Natural History), is one numbered 38 and labelled "Young Sting Ray. Kejetuck or Bebil". It apparently represents this species, and the names given are Australian aboriginal.

Family Dasyatidae.

Himantura toshi, *sp. nov.*

Himantura arnak or *uarnak* of Australian authors, not *"Raja arnak"* Forskal, Descr. Anim., 1775, p. ix., non-binomial, from the Red Sea.

The Coachwhip Ray of Australia requires a new name since Forskal's is non-binomial and his brief description is inapplicable to our form. The very long tail, generally two to three times the length of the body, and lacking cutaneous folds, is characteristic. The coloration of the disc is very variable: I have seen living specimens at Broome, caught at the same time and place, with plain, spotted or reticulated backs. The back usually has a single median spine, but may be smooth in the young and studded with rough denticles in adults. Australian specimens, so far as is known, do not reach the width of five feet claimed for the extralimital *arnak.*

Named after the late Dr. James R. Tosh who figured the species in his excellent "Notes on the Habits . . . of the Common Food Fishes of Moreton Bay" (Parliament. Rept. Qld. C.A., 74-1903, Rept. Marine Dept., 1902-1903, Append., No. 7, p. 4, pl. v., fig. 2). After having been associated with the Fisheries Board of Scotland, Tosh came to Australia and pioneered the work of investigating the eggs and young of our commercial fishes as Marine Biologist to the Queensland Government. He then became Professor of Biology at St. Andrew's University, and eventually met his death in Mesopotamia.

Holotype (Austr. Mus., Regd. No. IA. 39) from the Clarence River estuary, New South Wales, and recorded by D. G. Stead, Addit. Fish-Fauna, N.S.W., i., 1907, p. 2.

Family Aetobatidae.

Myliobatis hamlyni Ogilby.

(Fig. 18.)

Myliobatis hamlyni Ogilby, Ann. Qld. Mus., No. 10, Nov. 1, 1911, p. 40, and of later Queensland lists.

Mr. H. A. Longman, Director of the Queensland Museum, kindly sent me Ogilby's holotype for figuring. The teeth and spine have been removed from the specimen, and the width of the disc is now 270 mm. It is an immature male and may even be a juvenile of *australis,* but I keep the two species apart until intermediate specimens are found. Ogilby's *hamlyni* has narrower teeth, longer tail, different colour, and slightly differently formed head from the southern species.

Locality.—Cape Moreton, South Queensland; deposited in the Queensland Museum by the Amateur Fishermen's Association of Queensland. No. I. 1567.

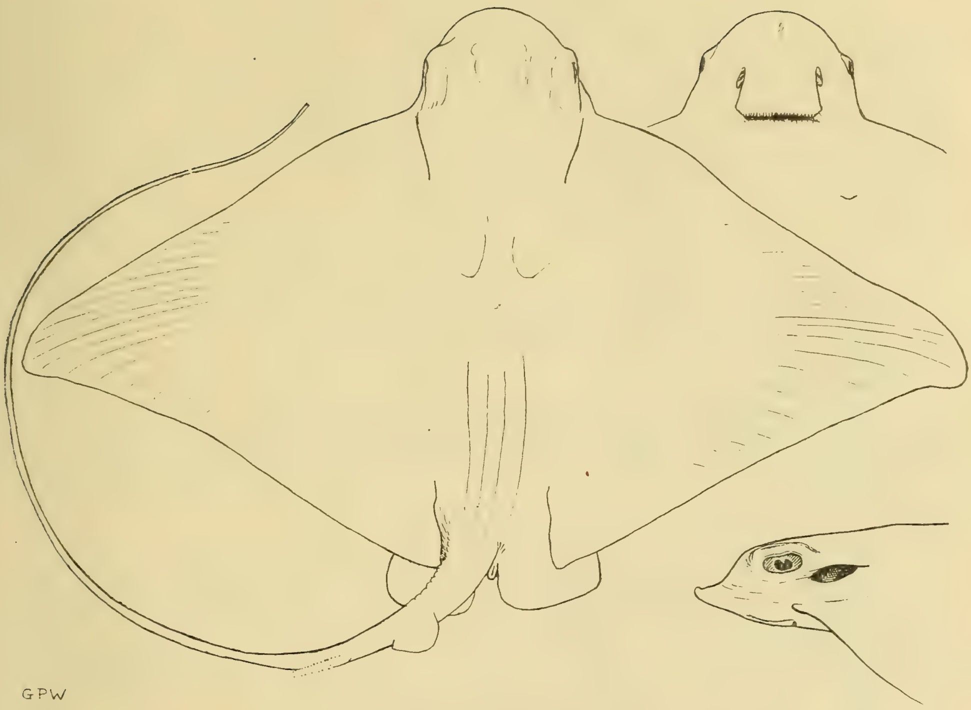


Fig. 18. *Myliobatis hamlyni* Ogilby. Holotype from Cape Moreton, Queensland (Qld. Mus., Regd. No. I.1567) . . . . G. P. Whitley *del.*

DEVIL RAYS (fam. Ceratopteridae & Mobulidae).

Since my paper on the Australian Devil Ray appeared in the Australian Zoologist (viii., 1936, 164), I have consulted books, manuscripts, and specimens in different Museums and have a few notes to add.

The type of *Ceratoptera ehrenbergii* Müller & Henle from the Red Sea is in the Zoologisches Museum der Universität, Berlin. It is a *Manta* (Whitley, loc. cit., p. 183) with terminal mouth, fair-sized dorsal fin, short thin tail without spine, small ventrals, and rough integument.

To the synonymy of Shaw's *Mobula diabolus* (loc. cit., p. 185) add *Cephaloptera tatraniana* Van Hasselt, Algemeene Konst- en Letter-Bode, i., May, 1823, p. 316, based on Russell's pl. ix., type of Shaw's species. Van Hasselt's name appears to have been overlooked by zoologists but is listed in Sherborn's Index Animalium, 1801-1850 (June, 1931), p. 6390; the rare book in which it was proposed was consulted in the British Museum, Bloomsbury.

Mobula rochebruni (Whitley, loc. cit., p. 187) should be *rochebrunei.* Vaillant's original description, which I saw at the British Museum (Nat. Hist.), South Kensington, states that there are teeth in both jaws, there being 50 from side to side and 10 from front to back ("une cinquantaine de rangées transversales et une dizaine en profondeur").

In the library of the Museum of Natural History, Jardin des Plantes, Paris, there are stacks of old manuscripts and drawings relating to fishes, many of them Australasian species. There is a particularly historic series of drawings and notes on Devil Rays, including LeSueur's original MSS and figures of the American species, drawings of Milbert's New York specimen and of a Kingston (Jamaica) one and Bancroft's autographed manuscript account of the same. Some of the Devil Ray drawings are very old and were used by Lacépède, whose type-localities were not always given. Thus I saw the original drawings of the following:—

1. Raie banksienne. Drawn in water as it swam following an Eastindiaman.
2. Raie manatia. Type-locality, on the ancient original drawing: America.
3. Raie frangée. Original drawing has Remorae. Loc.—Lat. N. 38°18min.; Long. S. [? West] of Paris 42°10min.; 23/7/1782.
4. Raie giorna.
5. Raie giorna.
12. Raie fabronienne. A *Mobula* from no stated locality.
14. A Devil Ray with white chevron-marks on shoulders. No locality.
15. A tracing from Barbot, Coll. Voy. & Travels, v., 224, pl. 29. Whipray, *Mobula*?

18-19. Aodon cornu. In this case, a *Mobula*.

22. A poor drawing. Loc.—28°N. by 65°W. July, 1827.
26. *Cephalopterus*, Cap bonne Esperance. Bears an unpublished new name from Quoy & Gaimard's MS.

—. Paintings of *Raja mobular* from Villefranche, 1807.

27. *C. kuhlii*. Java.
28. *Cephaloptera*. The specific name is unpublished, from Valenciennes, MS. No locality. A *Manta* of a green colour.
29. Ikan galemma. A *Manta*, evidently from Malaya, from the name.
30. *Cephaloptera*, with an unpublished specific name. Red Sea (Ehrenberg) = *Manta ehrenbergii*.

In addition to the Devil Ray material, the library at the Jardin des Plantes has all the originals of Cuvier & Valenciennes' plates and many apparently unpublished ones, also those of the *Astrolabe* and *Venus* voyages. There is much MSS by LeSueur—neat, detailed, and with exquisite drawings—but mostly American; the Australian MSS and drawings of Péron and LeSueur are apparently at Le Havre, but unfortunately I had insufficient time to ascertain. The Paris library has a considerable amount of Verreaux MSS from Australia and Tasmania.

Amongst Quoy's original drawings (many still unpublished) for the *Astrolabe* plates, I noticed the following elasmobranchs:—

pl. liv. Squale pris au Port Jervis. [A Grey Nurse, *Carcharias arenarius*].
lv. Raie de Western. Pour M. Cuvier. [*Myliobatis australis*?].
ccxxi., 1. Raie à lunettes. Nouv. Hollande. [*Urolophus cruciatus*].
,, 2. Rhinobate parquété. [*Trygonorrhina fasciata*].
ccclxx., 1. Roussette de Diemen. [*Cephaloscyllium laticeps*].
ccxviii. Brain of Squalus glaucus. New Zealand.
ccxix., 1. Brain of Squalus glaucus. New Zealand.
,, 2. Squale Philip. N. Holl.
ccxv., figs. 1-5. Appareil auditif. Sq. carcharias. Nlle. Hollande. Quoy.
ccxix. (bis) [A young seven-gilled shark] Ile van Diemen.

ccxx. [Two sharks]. Nouvelle Zélande.
ccclxix. [*Squalus* spp., white-spotted, and a plain male]. Ile Van D.

We see from the plate numbers that the results of the *Astrolabe* voyage, had they been published, would have been voluminous. Amongst Quoy and Gaimard's MSS on sharks were several drawings bearing new names which do not appear to have been published to this day. As the species have been named by others, it would only cause confusion to print the manuscript names here, so I merely mention a new *Scyllium* from Port Dorey, New Guinea, and another from Van Diemen's Land, a "*Squalus glaucus* auctorum" from "détroit de Cook", New Zealand, the seven-gilled shark from Tasmania, and some new species of *Spinax* from New Zealand and Tasmania. Had these new species been published a century ago, our knowledge of our sharks and rays would have been more advanced than it is now. Quoy & Gaimard's MSS also contain original descriptions of Basking Sharks. A drawing labelled *Scyllium pantherinum* A. Val. Leyden, 1827, shows a Javanese *Stegostoma* collected by Kuhl and Van Hasselt and named by Müller & Henle in 1838. There is one teratological example: Drawing No. 147 is of a double-headed shark, apparently a *Mustelus,* labelled "Squalus glaucus, pris dans le tage et envoyé à M. le Cte de la Cepede par M. Vandelli. I . . . Lisbonne [indistinct here], 1807".

Family CHIMAERIDAE.

Genus PHASMICHTHYS Jordan & Hubbs, 1925.

Phasmichthys Jordan & Hubbs, Mem. Carnegie Mus., x., 2, June 27, 1925, p. 119. Orthotype, *Chimaera mitsukurii* Jordan & Snyder, Proc. U.S. Nat. Mus., xxvii., Jan. 23, 1904, p. 224, fig. 2, *ex* Dean MS., from Sagami Bay, Japan.

PHASMICHTHYS LEMURES, *sp. nov.*

(Plate xxii., fig. 2.)

Form elongate, compressed, tapering, of the usual Chimaeroid form, with the snout blunt, not produced. The general habit and the ramifications of the lateral line system (which is wavy on sides of body) may be seen from the accompanying figure. Eye, 15 mm. Length of head, 47. Width of head, 25. Depth of body, 44. Dorsal spine, 38. Pectoral fin, 70. Length of fish (excluding caudal filament) 290, plus filament, 190 = total length, 480. Distance of nostrils from end of snout nearly half length of head.

Seven enamel rods on each anterior lamina of upper jaw, the median ones longest. A single large rod on each side of median line of lower jaw, the fused margin of the lower dental plate being strongly excavate.

Dorsal spine serrated on each side of the shallow groove posteriorly. The first dorsal fin is longer than the spine and connected to the second by a rayless membrane. Margin of second dorsal fin straight, not notched or excavated. Upper lobe of caudal fin less extensive than lower. No anal fin. Pectorals reaching beyond ventral base. Ventrals shorter than dorsal spine. Tail continued as a long thick "filament".

Colour (in formalin) greyish-pink, perhaps originally silvery. Fins brownish, the subcaudal fin being dark brown as is also a marginal band along second dorsal. No ocelli on body but a brown stripe runs along the back and a short, indistinct brownish stripe occurs on the sides of the body. Nose yellowish. Eyes and operculum bluish. A long cream caudal filament.

Described and figured from the holotype of the species, the larger of two female specimens, 18 to 19 inches long. Austr. Mus., Regd. No. E. 3591 (holotype), E. 3590 (paratype). There is a crustacean parasite on the caudal filament of the holotype.

Locality.—Western Australia: Great Australian Bight, S.W. from Eucla at 126°45½min., E. long. at 190 to 320 fathoms depth (F.I.V. "Endeavour", 4th April, 1913).

EXPLANATION OF PLATES AND FIGURES.

(Plate xx., fig. 1.)

Raja cerva Whitley. Holotype from Bass Strait. (Austr. Mus., Regd. No. E. 4970.) .. .. Mary Soady *del.*

(Plate xx., fig. 2.)

Urolophus (*Trygonoptera*) *mucosus* Whitley. Holotype from Albany, Western Australia. (Austr. Mus., Regd. No. IA. 670.) .. .. Joyce Allan & G. P. Whitley *del.*

(Plate xxi.)

Zearaja nasuta (Müller & Henle). A young specimen from the Portobello Marine Hatchery, New Zealand. (Austr. Mus., Regd. No. IA. 7087.) .. .. Joyce Allan *del.*

(Plate xxii., fig. 1.)

Pavoraja polyommata (Ogilby). Lectotype from off North Reef, Queensland. (Austr. Mus., Regd. No. I. 10904.) .. .. Joyce Allan *del.*

(Plate xxii., fig. 2.)

Phasmichthys lemures Whitley. Holotype from the Great Australian Bight (Austr. Mus., Regd. No. E.3591) .. .. Mary Soady *del.*

A NEW NOMENCLATOR ZOOLOGICUS.

Nomenclator Zoologicus (Zoological Society of London), 4 Vols., 1939. Edited by S. A. Neave. Price, 8 guineas, post free.

A specimen copy of this valuable work of reference has been submitted for review, but the complete work is expected from London at any time now. Zoologists have long felt the need for a handy Nomenclator or Index to the vast number of generic names of animals which have been applied from the time of Linné (1758) to the present day. The *Nomenclator Animalium,* being published by the Prussian Academy of Science, is a large work, incomplete, hitherto expensive and now unobtainable, so that we can welcome Dr. S. A. Neave's excellent new English production, the *Nomenclator Zoologicus,* which appears to be remarkably complete, of handy size, and reasonable price, the latter having been made possible by generous donations from Societies, the Carnegie Corporation, and private donors. Not only are all the generic names listed alphabetically, but, in the case of homonyms, of which there are some 18,000, cross-references indicate any new names which have been proposed for preoccupied ones. For this service alone, sighs of gratitude should arise from Museums and Universities all over the world to the Zoological Society of London for this indispensable *multum in parvo*. The whole work contains more than 225,000 entries, believed to represent about 192,000 distinct genera and subgenera in the Animal Kingdom; of these, the names of insects outnumber those of all other animals.

—G. P. WHITLEY.

BEES FROM THE HIGH LANDS OF NEW SOUTH WALES AND VICTORIA.

By TARLTON RAYMENT.

(Plates xxiii. and xxiv.)

For several years small collections of bees have been coming to hand from various localities in the mountainous portions of New South Wales. The Apidae of these high lands have not hitherto received much attention, consequently, it is of interest to receive not only new species, but also forms varying at the higher altitudes from the types. The distribution of some of the species is remarkable, since the *Stenotritus* is identical with one described from Rottnest Island, W.A.

A surprising amount of material has been gathered by John Hardcastle, White Swamp, Macpherson Range. Wilson's Peak, on the borderline of Queensland, rises 4,500 ft. above sea level. He was fortunate enough to discover the nidus, hitherto unknown, of *Meroglossa* and *Allodapula,* and the complete life-histories of these, and several other bees, are awaiting publication.

Another correspondent, Phillip Whiteley, Orange, Western Slopes, made several ascents of Mount Canobolas, which is twelve miles from Orange, and rises to 4,610 ft. He discovered the nidus of *Euryglossimorpha,* hitherto unknown, and the biology of this bee is awaiting publication; the difficulty is finding suitable media to accept such papers.

The other records have been made by either myself or the persons whose names are included in the notes; a number came from the Gosford district, which includes Woy Woy. Although I visited these places several times I was not very successful in collecting owing to the dryness of the season.

The work on the Australian bees is being assisted by a grant from the Trustees of the Commonwealth Science and Industry Endowment Fund.

Order HYMENOPTERA.

Suborder HETEROPHAGA.

Division COLLETIFORMES.

Superfamily APOIDAE.

Family HYLAEIDAE.

HYLAEUS ARNOLDI, *sp. nov.*

Female: Length, 10 mm. approx. Black, yellow markings.

Head transverse, oily-bright; face-marks limited to one minute yellow spot at apex of supraclypeal area; frons with a fine carina reaching the median ocellus, closely punctured; clypeus and supraclypeal area finely aciculate, with a few scattered shallow punctures; vertex roundly developed, closely punctured, a few white hairs; compound eyes black, reniform, converging below; genae minutely lineate, with close puncturing; a distinct malar space; labrum black, with a median circular elevation; mandibulae short, stout, obscurely brown; glossa broad and short; antennae with black scapes, flagellum amber beneath.

Prothorax black, more minutely punctured; tubercles large, convex, chrome-yellow, a fringe of white hair, a crescentic dusky mark at apex; mesothorax bright, minutely tessellate, with close coarse puncturing, and

minute appressed white hairs; scutellum and postscutellum chrome-yellow, dull, close punctures; metathorax with a large area having a scale-like sculpture, surrounded by close puncturing, a few pale hairs laterally; abdominal dorsal segments closely punctured, with minute appressed pale hairs, the posterior margins very narrowly polished and impunctate, apex with a little black and white hair; ventral segments similar.

Legs black, the white hair conspicuous only on posterior tibiae; tarsi black; claws bifid, reddish; hind calcar dark-brown, finely spined, like a Cycad leaf; tegulae black, tessellate, a few punctures anteriorly; wings dusky, nervures dark-brown, first recurrent well beyond first intercubitus, second recurrent meeting the second intercubitus; cells: the second cubital large; pterostigma dark-brown; hamuli eight, of medium development.

Male: Length, 8 mm. approx.

Head long, lateral face-marks excavated in a semicircle around insertion of antennae, and again at apex, points of which are away from orbital margin; frons densely and closely punctured, with a fine carina; clypeus and supraclypeal area ivory-yellow, weakly aciculate, indistinct punctures; vertex closely punctured; compound eyes converging strongly below; genae closely punctured; a distinct malar space; labrum blackish, a median elevation; mandibulae short and stout, obscurely brown; glossa acute; antennae wtih dilated scapes, yellow anteriorly, flagellum long, ferruginous beneath, darker above.

Prothorax, tubercles, mesothorax, scutellum, postscutellum and metathorax as in the female; abdominal dorsal segments somewhat constricted posteriorly; ventral segments simple.

Legs black, except the anterior pair, which have brownish tarsi and a yellow stripe anteriorly; tarsi black, with white hair; hind calcar blackish; hamuli five, very weak.

Locality: Black Sands, Yarra Valley, Victoria (March, 1936, A.d'H.G.).

Type and allotype in the collection of the author.

Allies: *H. aureomaculatus* Ckll., which is larger, with a tiny supraclypeal mark, and smaller scapes; size of puncturing on abdominal segment I much larger, and a yellow spot on median tibiae. *H. nubilosellus mediostictus* Ckll., has a minute spot on supraclypeal area (absent on some specimens) and exceedingly fine yellow lateral face-marks.

Species dedicated to Arnold d'Henzil Gosewinckle for his assistance in collecting. Copulating on flowers of *Hakea* ? species.

SPHAERHYLAEUS PROCURVUS, *sp. nov.*

(Plate xxiii.)

Male: Length, 6 mm. approx. Black.

Head slightly longer than wide; face-marks yellow, truncated at apex on a fine transverse line; frons minutely punctured on a tessellated sculpture; clypeus entirely yellow, close fine punctures, a few white hairs; supraclypeal area black, very long, finely striate; vertex more or less striate, a few punctures and a few white hairs; compound eyes appear emarginate, viewed from the front, they look like a wasp's, being overlapped by huge polished black rims, unique among bees; genae finely striatopunctate; labrum black, oval; glossa excessively short; mandibulae long, acute, bidentate, black at base, amber, and red apically; antennae with huge sub-

circular black scapes, with one margin yellow, second segment dilated, others submoniliform, black above, red beneath.

Prothorax black, a few white hairs, striate; tubercles yellow, with a white fringe; mesothorax dull, minutely striate, densely punctured, from certain angles, the sculpture as shown in the plate; scutellum similar; postscutellum rougher; metathoracic area large, with the peculiar sculpture shown in the plate; abdominal dorsal segments black, sparse punctures among the fine striae, hind margins lighter and depressed, with a small cluster of white hair laterally; ventral segments similar, 3 and 4 each having a pair of low mammiform nodes.

Legs black, apices of tibiae yellow, anterior tibiae ferruginous in front; a few white hairs; basitarsi yellow at apex, other segments dark, hair yellow; claws reddish, anterior and median simple, posterior bifid; hind calcar pallid, finely spined like a Cycad leaf; tegulae dull, piceous, with a yellow spot; wings dusky, radial cell darker, and pointed on the costal margin; nervures: arched basal just short of nervulus, second recurrent meeting the intercubitus; cells: second cubital half the size of the first, and contracted at apex, receiving the first recurrent at one-fifth of its length; pterostigma small, brown; hamuli five, very weak.

Locality: Bogong High Plain (6,000 ft.), Victoria (January, 1928, F. E. Wilson).

Type in the collection of the author.

Allies: *S. globuliferus* Ckll., which is much larger, with teeth on the gaster, but lacks the eye rims.

The remarkable polished processes, on the anterior orbital margins, appear to be developed at the expense of the lower portion of the frons, so that two excavations accommodate the large scapes as Professor Cockerell explained in his description.

When the head is viewed laterally, the thick rims project sufficiently to guard the scapes from injury. The emarginate eyes distinguish many wasps, and the structures here described undoubtedly have an ancestral relationship to the peculiar orbits of the wasps, and provides another stage in the evolutionary scale.

One postulates that similar rims in a PROTOHYMENOPTERON caused a suppression of certain cornules in the compound eyes, the rims have disappeared, but the emarginate shape remains. In this genus of bees the rims remain, because they are small, and sufficiently distant from the cornules to have no effect on the function of the eye.

Though published as a subgenus of *Gnathoprosopis*, the remarkable structures warrant generic rank.

HYLAEUS NUBILOSUS MEDIOSTICTUS Ckll.

Two females, typical in every character. One female lacking the minute supraclypeal yellow dot.

Gladesville, October, 1936 (Ian Dutton).

HYLAEUS GRACILICAUDIS Ckll.

One female, with a minute yellow spot on the postscutellum; punctures of the mesothorax of two sizes. I conclude this is only a race, but it is a new record for the State, the species being described from King George's Sound, W.A.

Gosford, January, 1934 (H. Cambourne).

Hylaeus asperithorax (Raym.).

One female, differing from the type by having the flagellum ferruginous beneath, and the pale narrow face-marks very obscure.

Woy Woy, February, 1934 (R. Willey).

Hylaeus philoleucus Ckll.

One female, typical.

Gosford, December 12, 1934 (H. Cambourne).

Two females, larger than the type.

Gunbower, V., February 20, 1934 (Rayment).

New records for both States. Described from Mackay, Queensland.

Hylaeus ruficeps (Sm.).

Several females, not typical, having no black on the frons; antennae entirely bright-fulvous (scapes black in type); no yellow mark near tubercles; yellow obscure on prothorax; black mandibles (fulvous in type); clypeus deeply suffused with black; abdomen bright-red, or obscure red.

Gunbower, Vic., March, 1934 (Rayment).

Described from Adelaide. Taken on flowers of *Callistemon* sp.

Hylaeus chrysognathus Ckll.

Males and females indistinguishable from Sandringham, Vic., specimens. I have worked out the complete biology of this bee, and it is awaiting publication.

White Swamp, April, 1939 (J. Hardcastle).

Sandringham, Vic., September to April, 1939 (Rayment).

Hylaeus gosfordensis, *sp. nov.*

Male: Length, 9 mm. approx. Black, abdomen purple.

Head long, shining; face-marks yellow, excavated around base of scape, and truncated at an angle of 45°; frons rugoso-punctate, extremely short; clypeus yellow, finely aciculate, scattered punctures, anterior half of margin finely lined with black; supraclypeal area yellow, roughly truncate, at apex almost reaches the median ocellus, with upper half black; vertex rugoso-punctate; compound eyes converging slightly below; genae coarsely punctured, a few white hairs; labrum yellow; mandibulae blackish-blue at base, reddish apically, bidentate; antennae black, submoniliform, flagellum ferruginous beneath.

Prothorax black; tubercles large, yellow; mesothorax dull, with large punctures well spread over a tessellate sculpture; scutellum and post-scutellum with a half-circular yellow mark, punctures not so close; metathorax with an inclosed area formed like a Moorish arch, coarsely rugose at base, and shining; abdominal dorsal segments polished, brilliant bluish-purple, large close puncturing, near the narrowly depressed hind margins the puncturing is denser and finer; hair at apex black; ventral segments similar.

Legs purplish-black, anterior femora and tibiae, and median tibiae yellow in front, a yellow spot on median femora at apex; tarsi blackish; claws dark-red; hind calcar pallid; tegulae rufo-piceous, with a yellow

spot; wings hyaline; nervures black; first recurrent meeting first intercubitus; second cubital cell very long, somewhat contracted on radial; pterostigma blackish; hamuli five, weak.

Locality: Gosford, January, 1934 (H. Cambourne).

Type in the collection of the author.

Allies: *H. chrysognathus* Ckll., which has yellow on mandibles, and a more closely punctured black abdomen and thorax.

HYLAEUS WOYENSIS, *sp. nov.*

Male: Length, 4 mm. approx. Black.

Head transverse, shining, closely punctured; face-marks creamy, diverging from half-way up the clypeus to end acutely on the orbital margin; frons closely and coarsely punctured; a large polished area, with a conspicuous pit, on each side of the supraclypeal area; clypeus creamy, apex cut off squarely, aciculate, closely punctured; supraclypeal area similar, but black; vertex closely punctured; compound eyes converging below; genae punctato-striate; labrum cream; mandibulae cream, reddish tips; antennae black, an obscure cream stripe on the slightly thickened scapes.

Prothorax hardly visible from above, black; tubercles black, a few whitish hairs; mesothorax coriaceous, but closely punctured; scutellum and postscutellum similar; metathorax with coarser sculpture, and short rugae basally; abdominal dorsal segments black, slightly depressed apically, a few white hairs; ventral segments similar.

Legs black, knees and a stripe on anterior femora creamy; tarsi more or less amber, hind basitarsi cream; claws reddish-amber; hind calcar amber; tegulae black; wings dusky; nervures brown; the recurrents at equal distance inside the intercubiti; second cubital cell like a trapezium; pterostigma large, brown.

Locality: Woy Woy, February, 1933 (R. Willey).

Type in the collection of the author.

Allies: Collected at the same time and place as females of *H. asperithorax* (Raym.), to which it is very close.

EURYGLOSSA MACULATA TUBERCULATA, *subsp. nov.*

Six females, with dark flagellum and legs, and only median and anterior knees, stripe on anterior tibiae, and tubercles butter-yellow; tegulae piceous, but axillae yellow; nervures and pterostigma dark-amber.

Gosford, December, 1933 (H. Cambourne).

EURYGLOSSA PERDITIFORMIS Ckll.

One female, differing from the type by having a black macula laterally on the second abdominal segment; two triangular black marks on the mesopleura; no supraclypeal mark; postscutellum entirely yellow; scutellum with a large black oblong mark; abdomen with numerous long black coarse hairs on dorsal plates. The numerous black and yellow markings on this bee cannot be accurately described in lucid language. If this specimen be distinct from the species it might have the name *hirsuta.*

Gosford, December, 1933 (H. Cambourne).

Euryglossa leptospermi Ckll.

Two females, not quite typical, having more green.
White Swamp, June, 1939 (J. Hardcastle).

Euryglossa brachycera Ckll.

One female, quite typical.
Wentworth, January, 1934 (T. Clarke).

Euryglossa halictoides, *sp. nov.*

Female: Length, 6 mm. approx. Green and red.

Head dark prismatic-green; very broad; frons with a scale-like sculpture and large scattered punctures; clypeus and supraclypeal area bright, bronze-green, scattered punctures, delicate sculpture; vertex with two lateral dark marks along foveae; compound eyes with anterior margins parallel; genae green; labrum light-amber; mandibulae yellow, with amber tips; antennae black above, ferruginous beneath.

Prothorax not visible from above; tubercles amber; mesothorax bronze-green, bright, with well-defined sculpture and scattered large shallow punctures; scutellum bluer, but sculpture similar to mesothorax; postscutellum bronze-green; mesothorax similar, but minus punctures; abdominal dorsal segments light-ferruginous, each with a narrow darker suffusion transversely and a black macula laterally; ventral segments with a few white hairs.

Legs ferruginous, with dark coxae and femora; tarsi amber; claws reddish; hind calcar reddish; tegulae amber; wings clear; nervures dark-amber; cells: second cubital receives both recurrents just inside; pterostigma large, reddish-amber; hamuli five, very weak.

Locality: Frankston, Victoria (March 16, 1939, Rayment).
Type in the collection of the author.

Allies: *E. subinconspicua* Raym., is smaller, with dark labrum and antennae. The new species looks just like *Halictus tarltoni* Ckll.

Entering galleries in pure beach-sand a few feet above high-water mark.

Euryglossa calliopsiformis Ckll.

One male, typical in all characters. One female, not typical, the abdomen having a wide yellow band on segments two and three, and the frons a larger quadrate yellow mark. Observed to enter shafts in the ground.

Described from Mackay, Queensland.
Mount Canobolas, February, 1936 (P. Whiteley).

Euryglossa variabilis Perk. var. *A.*

Typical females of the four known forms of this species, and identical with specimens which I collected at Gunbower, Vic. Flagellum black on Gunbower specimens.

White Swamp, January, 1939 (J. Hardcastle).

Euryglossa rubricata Sm.

Three females, quite typical. These, and the two preceding species, were observed digging together in the cultivated red volcanic soil of the garden. Species widely spread.

White Swamp, January, 1939 (J. Hardcastle).

Euryglossa inconspicua Ckll.

A series of males and females having blackish suffusions on legs like specimens from Orange, N.S.W. (Victorian specimens have the legs clear red). The sexes were taken *in cop.* on flowers of *Banksia* sp.

Taronga Park, Sydney, April 29, 1938 (Rayment).

A smaller female, with the head and thorax quite blue, and only tarsi and base of tibia ferruginous; second cubital cell receiving the recurrent nervures well inside.

Orange, N.S.W., December, 1936 (P. Whiteley).

Euryglossa schomburgki Ckll.

A female, 10 mm. in length, looking like a large form of *E. sericea,* with darker legs, and deeper-yellow wings.

Dobroyd Point, Sydney, December 14, 1925 (T. G. Campbell).

Euryglossa depressa Sm.

Two females, indistinguishable from specimens collected by me at Emerald, Vic.

Gosford, January 3, 1935 (Rayment).

Euryglossa subsericea Ckll.

One female, typical in all characters.

Gosford, January 3, 1935 (H. Cambourne).

Euryglossa ephippiata punctata, *subsp. nov.*

Five females, differing from the Adelaide type by darker wing neuration; postscutellum black; flagellum bright ferruginous beneath; clypeus with numerous coarse and fine punctures (scattered large ones in species); first recurrent vein received farther in second cubital cell; hind margins of dorsal segments of abdomen depressed.

Gosford, December, 1934 (H. Cambourne).

A series of females from Victoria have light-amber wing nervures; coarsely rugose clypeus. A variable species. One female, quite typical.

Dandenong, Vic., February, 1935 (Rayment).

Two females, typical in every character.

White Swamp, January, 1939 (J. Hardcastle).

Euryglossa rhodochlora scutellata, *subsp. nov.*

One female, differs from type (Yarrawin, N.S.W.), by scutellum and postscutellum suffused with red; abdomen ferruginous, basal basin of seg. one dark-green; segs. five and six dark-green; no median depression on clypeus; a dense post-occipital fringe of golden hair; flagellum dark-red beneath; wing nervures pale-amber; pterostigma dark brown.

Gunbower, Vic., February, 1934 (Rayment).

Euryglossa depressa sparsa Ckll.

One female, quite typical.

Gosford, December, 1934 (H. Cambourne).

EURYGLOSSA NEGLECTULA Ckll.

One female, quite typical.
Gosford, December, 1934 (H. Cambourne).

EURYGLOSSA CAMBOURNII, *sp. nov.*

Female: Length, 8 mm. approx. Black.

Head very wide, shining; broad face-marks yellow, squarely truncate at insertion of scapes; frons tessellate, dull; clypeus yellow, two minute short black lines laterally, bright sparse punctures; supraclypeal area with a wide, more or less oval, yellow mark; vertex sharply developed, a few black hairs; compound eyes with anterior orbital margins parallel; genae with scattered punctures; labrum black; mandibulae black, reddish apically; antennae submoniliform, black, flagellum ferruginous beneath.

Prothorax black, very small; tubercles yellow, large; mesothorax with two large yellow patches on anterior corners, dull, minute linear sculpture, scattered punctures, each with a short black curved spiny hair; scutellum and postscutellum entirely yellow, dull; metathorax with an ill-defined area like a moorish arch, minutely lineate; abdominal dorsal segments dull, obscurely purple, two and three impunctate, others with piliferous punctures, and scattered appressed hairs, apex with black hair, and a small red plate; ventral segments brownish, simple.

Legs black, a few white hairs; tarsi black, hair yellower; claws blackish; hind calcar pallid, with six strong teeth like *Paracolletes*; tegulae black, and dull like mesothorax; wings hyaline; nervures dark-brown, basal strongly arched, short of nervulus; cells: the two cubitals very long, the first longest, the second receiving both recurrents; pterostigma dark-brown; hamuli seven, very weak.

Locality: Gosford, January, 1934 (H. Cambourne).
Type in the collection of the author.

Allies: Not close to any described species, and should perhaps be the type of a new genus.

EURYGLOSSINA CHALCOSOMA CLARISTIGMA Raym.

Three females, which do not differ in any character from the subspecies which was described from Port Phillip, searching the earth in the vicinity of "nests" of *Euryglossimorpha nigra* (Sm.).

Mount Canobolas, January, 1936 (P. Whiteley).

EURYGLOSSIMORPHA NIGRA (Sm.).

A series of typical males and females, many of the latter stylopized. I have worked out the complete biology, and it is awaiting publication.

Mount Canobolas, February, 1936 (P. Whiteley).

Sydney, Clifton Gardens, October, 1937 (Rayment).

EUPROSOPIS ELEGANS (Sm.).

One male, smaller than usual, but otherwise typical.
Gosford, January, 1934 (H. Cambourne).

GNATHOPROSOPIS AMICULINA (Sm.).

Several females, typical in all characters.
Gosford, February, 1934 (H. Cambourne).

BINGHAMIELLA ANTIPODES (Sm.).

One female, with a very much longer, narrower and more pointed body, brighter red in colour. This may not be conspecific with Victorian specimens.

Woy Woy, February, 1934 (R. Willey).

Gosford (very dark wings) (H. Cambourne).

PACHYPROSOPIS OBESA Ckll.

Eight males, not quite typical, being clear-red on abdomen, and much larger (blackish bands in type).

Gosford, February, 1935 (H. Cambourne).

PACHYPOSOPIS ANGOPHORAE Ckll.

One male, quite typical.

Gosford, February, 1935 (H. Cambourne).

PACHYPROSOPIS ALBONITENS Ckll.

Several males and females linking up with *disjuncta*. These are a larger mountain race, the males having light flagellum and yellow scape, and hind legs blacker; the female having lighter antennae, a black finely aciculate clypeus; nervures of wings blacker; median tibiae having no yellow spot; tegulae black.

White Swamp, June, 1939 (J. Hardcastle).

MEROGLOSSA DESPONSA Smith.

There is a group of rather large—10 millimetres or so—black, shining bees with chrome-yellow markings, but very little body hair. The yellow is very conspicuous, that on the "face" being shaped like a long diamond; the collar having a line; tubercules, and on some a large lunate mark behind them; and a large yellow mark on the scutellum and postscutellum; the wings are slightly dusky.

The face-marks vary somewhat, and the metathoracic area may be polished or rough, but I have determined that the species *desponsa* is a variable one, and that the several forms are best treated as subspecies, though it may be found later that those with the rough metathoracic area should have specific rank.

I have specimens of the species and its several forms from widely separated districts, from north of Brisbane down through New South Wales to the Grampian hills in Victoria. Clarence Borch collected one subspecies at the last-named locality, on the 1st November, 1928. John Hardcastle found a new species with its nest, at The White Swamp, on the Queensland-New South Wales border, on the 8th March, 1939. I myself took a subspecies at Clifton Gardens, Sydney Harbour, on 3rd September, 1937, and these dates suggest differences in the biology of the bees. However, the several bees may be separated by the following key.

	Metathoracic area polished	1.
	Metathoracic area rough	5.
1.	Lunate spot apicad of tubercles	*desponsa* Sm.
2.	Lateral spots on scutellum	*kershawi* Ckll.

3. Metathoracic area with weak rugae .. .. *punctata* Raym.
4. Larger, 13 mm. seg. one of abdomen with fine punctures .. .. *sydneyana* Raym.
5. Seg. one of abdomen with finer punctures .. .. *borchi* Raym.
6. Seg. one of abdomen with coarse punctures .. .. .. *hardcastlii* Raym.

MEROGLOSSA IMPRESSIFRONS TUBERCULATA, *subsp. nov.*

Male: Length, 10 mm. approx. Black and yellow.

Head coarsely punctured, shining; face-marks like two long slender yellow clubs on the orbital margins; frons deeply impressed, with a fine carina reaching the median ocellus, and a delicate sculpture which runs out in the deep polished channels at each side of the clypeus; supraclypeal area with a yellow triangle; clypeus with a yellow mark like a short thick anchor; vertex with two short bent foveae reaching the lateral ocelli; compound eyes reniform; genae coarsely punctured; labrum a small oval; glossa short and acute; mandibulae black; scapes dilated, flagellum ferruginous beneath.

Prothorax with yellow line interrupted in middle; tubercles yellow, with a fringe of white hair; mesothorax coarsely punctured; scutellum with a large yellow mark; black dots appear at bases of black hairs; postscutellum has a yellow oval not spotted, white hair; mesothorax polished, bigibbous; abdominal dorsal segments coarsely punctured, those on seg. one finer; ventral segments each with a pair of low tubercules.

Legs with sparse white hair; tarsi somewhat piceous; claws reddish; hind calcar finely serrated, blackish; tegulae black, with a yellow spot anteriorly; wings slightly dusky; nervures dark-brown, both recurrents received just inside the large second cubital cell; pterostigma blackish; hamuli nine.

Locality: Clifton Gardens, Sydney, September, 1937 (Rayment).

Type in the collection of the author.

Allies: The species lacks the tuberculate sternites, and has reddish anterior tibiae; *M. canaliculata* Sm. has yellow on the scapes.

On flowers of *Banksia* sp.

MEROGLOSSA TRIANGULATA, *sp. nov.*

Male: Length 12 mm. approx. Black.

Head with facial quadrangle longer than wide; frons with a few pale hairs; a deep wide channel at sides of "face"; clypeus finely aciculate, the sparse puncturing in rows, a broad cream band expanded at apex; supraclypeal area with a very small cream isoscles triangle; a fine creamy line, thicker above, bordering the orbital margins; vertex coarsely punctured; compound eyes converging slightly below; genae with a few white hairs; labrum black; mandibles black; scapes black, dilated, flagellum black above, creamy below.

Prothorax with two creamy marks laterally; tubercles creamy, with a large cream macula posteriorly; mesothorax shining, with large scattered punctures; scutellum and postscutellum of similar sculpture, the first bearing a cream equilateral triangle, and a cream spot at lateral corners; the second with a minute cream spot; metathorax so deeply impressed in middle as to form two conspicuous nodes; abdominal dorsal segments bright, with a delicate tessellation and scattered large punctures, apex with some black

hair; ventral segments with a few pale hairs, two small nodes on three and four.

Legs and tarsi black, slender, a few white hairs; claws reddish; hind calcar blackish; tegulae black, a few punctures and a cream spot; wings subhyaline; nervures blackish-brown; the second cubital cell extremely long, receiving the recurrents at equal distance from ends; pterostigma narrow and black; hamuli twelve, strongly developed.

Locality: Inverell, November, 1935 (P. Stephens).

Type in the collection of the author.

Allies: *M. desponsa* Sm., which has a large circular yellow macula on scutella, but no facial channels, and metathorax not developed to nodes.

MEROGLOSSA HARDCASTLEI, *sp. nov.* Text figure I.

Male: length, 11 mm. approx. Black, yellow markings.

Head wide; face-marks creamy-coloured and, with supraclypeal mark, extending up as three subtriangular lobes; large frons with a conspicuous fine carina separating two deep depressions—resembling in outline two kidneys placed together—which evidently accommodate the dilated scapes; clypeus entirely cream-coloured; supraclypeal area cream-coloured, and not separated structurally from the clypeus; compound eyes with peg-hairs between the facets; genae microscopically lineolate, with scattered punctures; labrum cream-coloured; mandibulae black, with a yellow stripe; scapes dilated, black, anterior surface yellow; flagellum black, brown beneath.

Prothorax with a minute median yellow spot; tubercles yellow; mesothorax minutely tessellate, with numerous coarse punctures, each with a short black hair; scutellum with a wide yellow band, white hair; postscutellum with a thick yellow crescent; metathorax with a large inclosed area finely tessellate, outside of this evenly punctured, some white hair laterally; abdominal dorsal segments closely punctured, coarsely and minutely, black hair at apex; ventral segments coarsely punctured, black hair.

Legs black, white hair, median tibia and anterior femur and tibia with a wide yellow stripe; tarsal hair slightly yellowish; claws reddish, large; hind calcar black, finely serrated; tegulae shining black, tessellate, coarsely punctured basally; wings dusky; nervures blackish-brown, the wide second cubital cell receiving both recurrent nervures equally inside; pterostigma black, large; hamuli seven, strongly developed.

Female: Length, 12 mm. approx. Black, yellow markings.

Head wide; face-mark a large long diamond-shaped yellow mark; frons closely and coarsely punctured, except in centre, where it is microscopically lineolate; clypeus finely aciculate, with large shallow punctures; supraclypeal area prominent, but carina not so sharp as in male; vertex coarsely punctured, black hair, foveae incurving to ocelli as in male; compound eyes long; genae finely lineolate, with even puncturing; labrum black, with a prominent oval protuberance; malar space large, finely aciculate as in male; mandibulae black; antennae black, brownish beneath.

Prothorax thickened, black; tubercles yellow; mesothorax as in male; pleura with even punctures of two sixes; scutellum and postscutellum with yellow marks as in male; metathorax as in male, with white hair; abdominal dorsal segments with hind margins depressed; ventral segments as in male.

Legs, anterior with a curled white pollen-sweeper; tarsi black; claws reddish; hind calcar black, finely serrated; tegulae as in male; wings with costal edge darker; nervures black; second cubital cell very long; pterostigma large, black; hamuli seven.

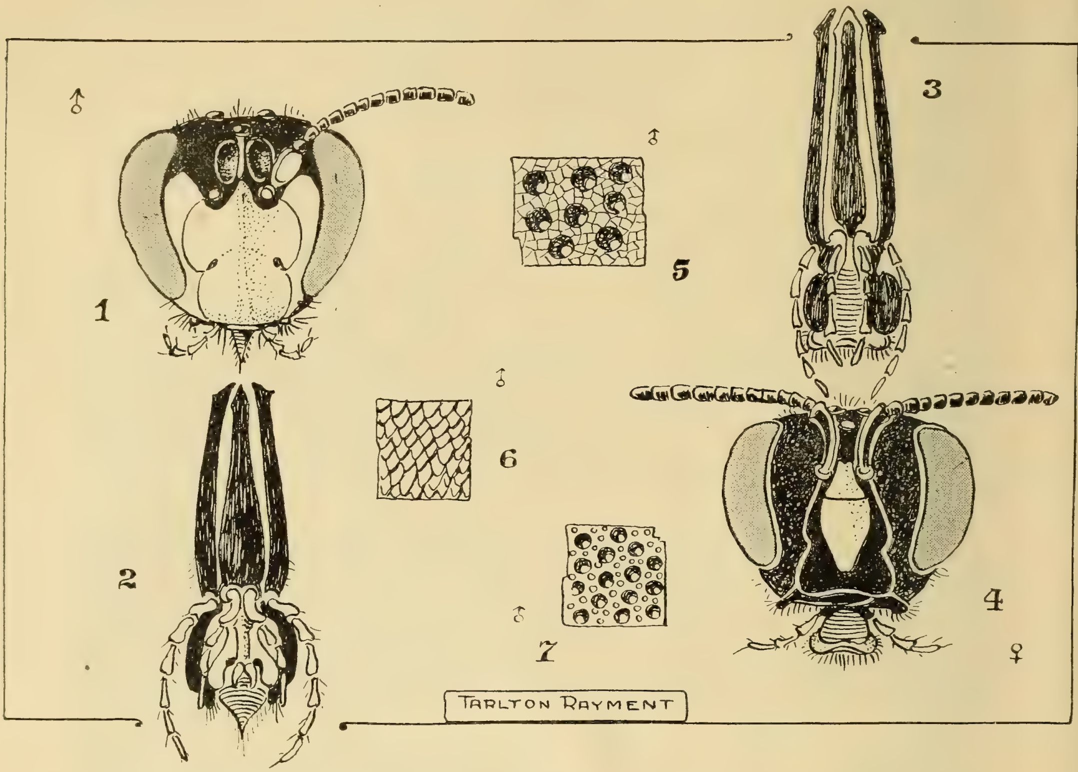


Fig. 1. *Meroglossa hardcastlei* Rayment. 1 and 2: Head capsule and mouthparts of male. 3 and 4: Same, of female. 5: Sculpture of mesothorax. 6: Of metathoracic area. 7: Of first abdominal segment.

Locality: White Swamp, Macpherson Range (J. Hardcastle, Junr.).

Type and allotype in the collection of the author.

Allies: *M. desponsa* (Smith). Reared from cells in twig of *Tristania conferta*. The complete biology is awaiting publication. These bees gather pollen from Tallow-wood, *Eucalyptus microcorys*.

Division COLLETIFORMES.

Family COLLETIDAE.

Subfamily DIPHAGLOSSINAE.

EURYGLOSSIDIA ACACIAE, *sp. nov.*

Professor T. D. A. Cockerell, to whom I submitted specimens of the red bees, writes:—"They are not *E. rectangulata*; comparing your female with a cotype, yours is larger, with redder wings, and a much darker abdomen, so that it has quite a different aspect".

Compared with *E. purpurascens,* the new bees do not have the dark-purplish colours at the base of the abdomen, being clear-red; the second cubital cell not so long; the first recurrent nervure not so far from base of the second cubital cell; tarsi and knees red; flagellum redder beneath; the clypeus without a longitudinal ridge, and the shining face of the supra-clypeal area not concave. The clypeus of typical *purpurascens* is flattened on the disc, with an obtuse ridge.

"Comparing the male with a cotype of *E. rectangulata,* yours has the disc of tergite 5 black, with blue reflections (which is not at all true of *rectangulata*), and yours also has darker nervures.

Considering the difference of locality, I should expect your bee to be new."

Locality: Emerald, Victoria, September, 1936 (Rayment).

Type and allotype in the collection of the author.

Taken on flowers of *Acacia verticillata,* where the sexes appeared to be copulating.

Trichocolletes venustus (Sm.).

A series of males and females quite typical. One male appeared as early as July 31, 1938.

White Swamp, December, 1938 (J. Hardcastle).

On flowers of Scaly Bitter-pea, *Daviesia squarrosa.* The bees in the several States are very faithful to the genus *Daviesia,* but the males hover over *Hardenbergia monophylla.*

Heterocolletes capillatus Raym.

One typical male. The genus and species was described from Victoria. Male from Wilson's Promontory, and female from Emerald, Vic. New record for State.

Mount Canobolas, February, 1936 (P. Whiteley).

Paracolletes providellus bacchalis Ckll.

A large series of typical males, indistinguishable from specimens taken by me at Croydon and Emerald, Vic.

Mount Canobolas, February, 1936 (P. Whiteley).

Gladesville (with smaller second cubital cell) October, 1936 (Ian Dutton).

Paracolletes plebius Ckll.

Female, typical in every character, and indistinguishable from specimens taken by me at Scoresby, Vic.

Mount Canobolas, February, 1936 (P. Whiteley).

Paracolletes irroratus (Sm.).

One male, differing from Emerald specimens by the bright-ferruginous underneath of flagellum; rougher disc of mesothorax, and scanty hair of the "face". Probably only a mountain form.

Taken on flowers of *Lomatia* sp.

White Swamp, June, 1939 (J. Hardcastle).

PARACOLLETES FIMBRIATINUS Ckll.

A series of robust females, taken as they were about to enter shafts in fine red volcanic soil of a cultivated area. Hair of these bees paler than that of type.

White Swamp, June, 1939 (J. Hardcastle).

PARACOLLETES MELBOURNENSIS Ckll.

Female, plainly between this and *cupreus,* having blackish tegulae and legs, with golden hair at apex of abdomen. Clypeus all metallic blackish. Approaches *P. chalcurus* Ckll.

Gosford, January (H. Cambourne).

PARACOLLETES MORETONIANUS Ckll.

First record for State. Described from Queensland.

Woy Woy, February, 1934 (R. Willey).

STENOTRITUS SUBMACRODONTUS (Raym.).

Two females, which are indistinguishable from one collected on Rottnest Is., W.A. A study of the females shows that they are not *Paracolletes,* in which I had placed the male from Rottnest Is. To my very great surprise, I find that the females are definitely in the genus *Stenotritus,* and a description of the allotype is appended. This record shows a remarkable distribution of the species.

STENOTRITUS SUBMACRODONTUS (Raym.).

Female: Length, 15 mm. approx. Black, green abdomen.

Head small, but broad; face with much pale-ochreous hair; frons coarsely and densely punctured; clypeus ridged, with close very coarse punctures, each with a long, fine, pale hair; supraclypeal area rising to a fine high carina that reaches and encircles the median ocellus; vertex with close huge punctures and many minute ones; compound eyes with anterior margins parallel; genae with long white hair; labrum black, polished, large; mandibulae black, reddish apically, with three large teeth; antennae black, scapes closely punctured, flagellum ferruginous beneath.

Prothorax not visible from above; tubercles black, hidden under the dense pale-ochreous hair of the pleura; mesothorax polished, scattered large punctures and a thick fleece of long pale-ochreous plumose hair; scutellum large, bigibbous, sculpture and hair like mesothorax; postscutellum with a great mammiform elevation coarsely punctured, long white hair; metathorax with a very large polished area bounded by a beaded line, long pale hair; abdominal dorsal segments silky-bright, darkest-green, hind margins with a reddish tint, punctures large and even; apex with a large naked plate, and much black hair; ventral segments each with a scopa of long curled white hair.

Legs black, strong and heavy, with white hair, scopa on exterior of hind tibiae black, but white on inner surface; hind tarsi with a thick black scopa; apical segment reddish; claws reddish; hind calcar reddish, finely spined; tegulae piceous, polished; wings dusky; nervures blackish and heavy; cells: the large second-cubital with parallel sides; pterostigma obsolete; hamuli seventeen, very strongly developed.

Locality: White Swamp, December, 1938 (J. Hardcastle).

Allotype in the collection of the author.

Family ANDRENIDAE.

Subfamily NOMIINAE.

NOMIA FERRICAUDA Ckll.

Three females, showing some variation from the type, and having the third abdominal band of white hair; the tegument of the fourth segment red on apical half; no white hair on base of third, but all have white hair on postscutellum. New record for State.

Gosford, December 12, 1932 (H. Cambourne).

White Swamp, June 6, 1939 (J. Hardcastle).

NOMIA FLAVOVIRIDIS Ckll.

Numerous specimens, all variable, from several localities.

Cooktown, Babinda and Mackay, Queensland (Rayment).

Tamworth, N.S.W. (Rayment).

Balwyn Park, Gunbower, Eltham, Bayswater, Croydon, Horsham and Broadmeadows, Victoria (Rayment).

Perth, W. Australia (L. Glauert).

NOMIA DENTIVENTRIS Sm.

One male, of typical form.

Gosford, December 15, 1932 (H. Cambourne).

NOMIA MOERENS ULONGENSIS Ckll.

One typical female.

Dorrigo (W. Heron).

NOMIA NANA Sm.

A large series of males, taken from a cluster which had assembled on a twig at evening. All were of typical structure, though they varied greatly in size.

Inverell, November, 1935 (P. Stephens).

White Swamp, February, 1939 (J. Hardcastle).

NOMIA AUSTRALICA NUDA, *subsp. nov.*

Two females. Head smaller; "face" devoid of hair on anterior half; longer scape red beneath; puncturing of mesothorax closer and larger; metallic tints of abdomen and hair-bands very dull; portion of flagellum red.

Inverell, November, 1935 (P. Stephens).

Taken while collecting pollen and honey from *Carduus* sp.

Several other females, distinguishable by the sculpture of the first abdominal segment. The tergum is depressed, and the hind margin, which is black, is depressed again, so that there are three areas, each of which is punctured differently, that of the black margin being scattered (it is dense in *reginae* Ckll.); the clypeus is suffused with reddish, the anterior part being impunctate; the second cubital cell is much longer.

Locality: Inverell, November, 1935 (G. Phillips).

Allies: *N. australica reginae* has the same sculpture on the metathorax, but specimens from Meningie, S.A. (H. Minchin), have very dusky wings, those of the new subspecies not so dark.

Family Halictidae.

Halictus lanarius Sm.

One female, apparently of the February brood, which has females of a different form, and are analygous to those of *Halictus emeraldensis* Raym. This female is indistinguishable from specimens taken from shafts at Emerald and Sandringham, Victoria, by me.

White Swamp (J. Hardcastle).

On flowers of *Senecio orarius.*

Canowindra, N.S.W., December 6, 1931 (Rayment).

Halictus tertius Dal. Tor.

One female, differs from type by reddish tints all over the abdomen, and entirely black antennae. (The scape is red in *H. rufipes* Sm.). Described from Melbourne, Vic. This mountain form has no hair-bands on abdomen.

White Swamp, June 10, 1939 (J. Hardcastle).

Halictus sanguinipes Ckll.

One male, indistinguishable from specimens collected at Emerald and Melbourne, Vic.

White Swamp, June 3, 1939 (J. Hardcastle).

Halictus humilis Ckll.

The several specimens of both sexes are typical.

Mount Canobolas, February 10, 1936 (P. Whiteley).

Halictus urbanus Sm.

There are several races of this species. Sydney specimens are larger, with other differences. Champion Bay, W.A., bees having three teeth on the hind calcar; N.W. Australian specimens of *H. urbanus bandinensis* Ckll. have only two teeth. Woy Woy, N.S.W., specimens are typical. A female to hand from Gladesville measures 6 mm. in length, is very robust, and has five teeth on the hind calcar. Woy Woy, specimens (R. Willey).

Gladesville, near Sydney, October 8, 1936 (Ian Dutton).

On flowers of garden poppies.

Halictus demissus Ckll.

Males and females, indistinguishable from Sandringham, Vic., specimens collected on the foreshore, and others taken at Sydney by myself.

Gladesville, October 8, 1936 (Ian Dutton).

Halictus eboracensis Ckll.

Mem. Queensl. Mus., vi., p. 117, 1918.

Male: Length, 9 mm. approx. Black.

I.—Further study of the biology of halictine bees reveals two kinds of females in certain species, those of the "bisexual broods" differing from the parthenogenetic generations.

(See the author's paper on the biology of *Halictus emeraldensis* Raym. Arbeiten über physiologische, und angewandte Entomologie aus Berlin, December, 1936, and March, 1937.)

Head transverse; face not so hairy as *seductus,* and frons rougher; clypeus with a similar yellow mark pointed in the middle; supraclypeal area shining; vertex rugose; compound eyes converging slightly below; genae with a few white hairs (dense in *seductus*); labrum black; mandibulae black, long, submoniliform, flagella obscurely brighter beneath.

Prothorax not visible from above; tubercles black, with heavy fringe of white hair; mesothorax coarsely rugose laterally, but more shining on disc; scutellum with a median sulcus, smaller punctures dense about margin; postscutellum has silver hair (drab in *seductus*); metathoracic area pointed posteriorly, with a few large radiating rugae; abdominal dorsal segments polished, but showing a delicate lineation and scattered minute punctures, scattered suberect pale hairs on apical half, and inconspicuous white patch laterally on segments two and three; ventral segments with much white hair.

Legs black, white hair; tarsi obscurely lighter at apex; claws reddish; hind calcar yellowish-amber; tegulae polished posteriorly, tessellate anteriorly; wings slightly yellowish; nervures amber; cells: the second cubital receives the first recurrent farther in than *seductus*; pterostigma brown; hamuli eight, weak.

Locality: Gunbower, Victoria, February 2, 1933 (Rayment). Also Sandringham (Rayment).

Allotype in the collection of the author.

Allies: *H. lanarius* Sm. has larger and closer puncturing on abdominal segments one and two; *H. repraesentans* Sm. has puncturing of two sizes on tergites; *H. seductus* Ckll. is smaller, but exceedingly close; the females are easier to distinguish. Refer to key. Described from Ebor, N.S.W.

Both sexes on *Callistemon* flowers at Gunbower; on *Leucopogon* at Sandringham.

The following key will assist students to separate six males which are exceedingly closely related, and all have a yellow mark of similar form on the clypeus, but the puncturing of the abdominal basal segments is decisive:—

	Small, vertex finely rugose	1.
	Much smaller, metathorax finely reticulate	6.
1.	Segments smooth, scattered minute punctures	*H. seductus* Ckll.
	Larger, vertex coarsely rugose	2.
2.	Segments smooth, minute punctures closer	*H. eboracensis* Ckll.
	Metathorax with a few coarse radiating rugae	3.
3.	Segments with puncturing of two sizes	*H. repraesentans* Sm.
	Metathorax with a fine reticulation	4.
4.	Segments with close puncturing of medium size	*H. lanarius* Sm.
	Transverse striae behind ocelli, vertex smooth laterally ..	5.
5.	Segments polished, scattered large punctures	*H. instabilis* Ckll.
6.	Segments dull, extremely close fine punctures	*H. asperithorax* Ckll.

HALICTUS ODYNEROIDES, *sp. nov.*

Female: Length, 8 mm. approx. Black, golden-orange spots.

Head circular from front; face with scattered golden hairs; frons so closely punctured as to appear rugulose; clypeus convex, polished, a few

large shallow punctures, ferruginous on apical half, a few long fine golden hairs; supraclypeal area prominent, polished, scattered large punctures; vertex with smaller scattered punctures; compound eyes claret-colour, reniform; genae prominent, anteriorly with a covering of long golden hair; labrum reddish; mandibulae bidentate, red, with a black margin; antennae submoniliform, bright red, scapes very long and slender.

Prothorax hidden in middle by mesothorax, but on each of the swollen corners, a large isosceles triangle of brilliant golden-orange moss-like hair; tubercles black, a heavy fringe of pale-golden hair, and apical a pale crescent; mesothorax dull, close small puncturing, with scattered large punctures, parapsidal grooves distinct, two large golden-orange hair-spots near scutellum; scutellum of similar sculpture; postscutellum covered with the golden-orange moss-like hair; metathorax with a large lunate area covered with a fine scale-like sculpture; abdominal dorsal segments claviform, one two and three black, dull, owing to the excessively close fine punctures, four, five and six orange-red integument with hair of brighter colour, two with basal band of golden-orange mossy hair; ventral segments black, with red margins, except six, which is entirely red, each with a scopa of long curled white hair.

Legs ferruginous, with some black on coxae and femora, long white hair with some stiff black on median and hind tibiae; tarsi reddish; claws reddish; hind calcar finely spined, reddish; tegulae fulvus; wings dusky, costal half extremely dark, especially the radial cell, so that the pterostigma and cell are almost indistinguishable; nervures: first recurrent meeting the second intercubitus; cells: the small second cubital almost quadrate; pterostigma large, translucent, with a dark outline; hamuli eleven, strongly developed.

Locality: White Swamp, Macpherson Range, May, 1939 (J. Hardcastle).

Type in the collection of the author.

Allies: Clearly in the *bicingulatus* group. A beautiful bee which, owing to the brilliant golden-orange hair-spots, superficially resembles an Odynerid wasp. Closest to *H. peraustralis* Ckll., which has yellowish orange hair on postscutellum.

On flowers of *Lomatia* sp.

HALICTUS GUNBOWERENSIS, *sp. nov.*

Female: Length, 6 mm. Green and red.

Head wide, scattered white hair; frons finely striato-punctate, iridescent bronze-green; clypeus dark-green, anterior half ferruginous; supraclypeal area light bronze-green, very shining; vertex with striae at right-angles; compound eyes reniform, claret-brown; genae with short white hair; labrum large and ferruginous; mandibulae yellow, with dark-red tips; antennae light-ferruginous (scapes black in a closely related female with dark-green scutellum).

Prothorax not visible from above; tubercles black; mesothorax brilliantly shining, light metallic-green, numerous fine punctures, and a few short white hairs; scutellum similar, punctures smaller; postscutellum darker, and rough; metathorax dark-green, a large lunate area with coarse anastomosing rugae, angles of truncation developed to a sharp point; abdominal dorsal segments orange-red, one with a large basal patch of bronze-green, finely punctured, a few scattered white hairs.

Legs clear light-red, long white hair, coxae blackish; tarsi reddish-amber; claws similar in colour; hind calcar reddish-amber, bent, with one large tooth and a wavy edge beyond; tegulae palest-amber; wings hyaline, iridescent; nervures palest-amber, outer recurrent and intercubitus weakened; cells: second cubital contracted at apex, third cubital quadrate; pterostigma palest-amber; hamuli six, weak.

Locality: Gunbower Is., Vic., March 3, 1933 (Rayment).

Type and allotype in the collection of the author.

Allies: *H. erythrurus* Ckll., which has a black patch on base of darker abdomen. The smaller females with the black scape are clearly linking forms.

Halictus erythrurus appositus, *subsp. nov.*

A female, from Hardcastle, with bright-red abdomen, and light-green thorax, provides a beautiful and unmistakable link with this species, and *H. gunbowerensis,* which is itself a link with *H. raymenti* Ckll. A Gunbower female, with black scapes, is exceedingly close to *erythrurus* and subsp. *appositus.* The specimens are extremely interesting, since they provide excellent examples of evolutionary gradations that are seldom available for study. The mountain form is very close to *H. gunbowerensis,* sp. nov., a description of which is appended.

Halictus erythrurus Ckll.

Several females, typical in all characters.

White Swamp, February, 1939 (J. Hardcastle), on flowers of *Senecio orarius.*

Halictus whiteleyi, *sp. nov.*

Female: Length, 6 mm. approx. Green, orange abdomen.

Head transverse, olive-green, shining; frons finely striate, punctures inconspicuous, scattered white hair; clypeus black on anterior half, with prismatic hues dividing it from the green posterior, polished, with scattered punctures of medium size; supraclypeal area shining, a few large punctures, and rising to a fine carina that reaches the median ocellus; vertex with transverse striae posteriorly; compound eyes claret-brown, reniform; genae with short white hair; labrum dark-red; mandibules blackish-amber basally, dark-red apically; antennae black, flagellum ferruginous beneath.

Prothorax black, a few white hairs laterally; mesothorax polished olive-green, anteriorly the green has a bronze lustre, and an iridescent line separates the two shades, anteriorly there is a lineolate sculpture; the scattered punctures are of two sizes, and there are a few white hairs which are more dense along the scutellar margin; scutellum similar; postscutellum green, darker and rougher; mesothorax shining green, with a wide crescentic area densely covered with fine anastomosing rugose, and angles of truncation developed to triangular points; abdominal dorsal segments clear orange, the fine punctures most conspicuous on basal one, a few pale hairs, and a microscopic white fringe on hind margin of each; dorsal segments with a scopa of curled white hair.

Legs black, all tibiae and femora apically clear ferruginous, a blackish suffusion on hind tibiae; tarsi ferruginous; scattered white hair on legs; claws dark-red; hind calcar amber, with one large rounded tooth; tegulae palest-amber, almost pellucid; wings hyaline, iridescent; first recurrent

nervure entering the second cubital cell at apical corner; small second cubital somewhat contracted at apex; pterostigma pale-amber, long; hamuli six, extremely weak.

Locality: Mount Canobolas (4,500 ft.), January, 1936 (P. Whiteley).

Type in the collection of the author.

Allies: *H. codenticalis* Raym., which has the much smaller area on metathorax with fewer rugae, and scapes ferruginous beneath.

I collected a closely allied species at Gunbower, Victoria, in February, 1934. This is easily distinguished by the darker abdomen, which is very similar to that of *H. erythrurus* Ckll., but the basal dark patch is olive-green, instead of black. This bee is between *H. greavesi* Raym. and *H. whiteleyi* Raym., and has ferruginous scapes.

Our increasing knowledge of the chromosomes makes it easier to appreciate the relationships of such forms, and clarifies our concept of what a species really is, and how it has been evolved. Therefore, it may yet be proved that the Gunbower specimens arose as a mutation of any one of four bees, *H. whiteleyi* Raym., *H. greavesi* Raym., *H. codenticalis* Raym., or even *H. erythrurus* Ckll. The exact relationship can be determined only by an investigation of the chromosomes of each, and this group would undoubtedly provide excellent material for such a research but, for the time being, I can do no better than describe it as a new species.

HALICTUS SPHECODOIDES Sm.

One female, not quite typical, abdomen clear red at base and apex, and blackish between.

Gladesville, October 8, 1936 (Ian Dutton).

HALICTUS OXLEYI Ckll.

Six females, that agree with the described male, and these are close to *H. frenchi* Raym., described from Adelaide.

Gosford, December 15, 1932 (H. Cambourne).

HALICTUS CAMBAGEI Ckll.

Not quite typical, the small second cubital cell greatly contracted at apex.

Albury, January 6, 1929 (F. E. Wilson).

HALICTUS PARACOLLETINUS Ckll.

Male, not typical, having no dusky tints on tibiae. Described from Cairns.

Woy Woy, N.S.W., February, 1934 (R. Willey).

HALICTUS TASMANIAE Ckll.

One female, not quite typical.

Sydney, September, 1937 (Rayment).

PARASPHECODES FROGGATTI Ckll.

A series of males having only segments five and six blackened dorsally.
Gosford, January, 1935 (H. Cambourne).

Parasphecodes sextus Ckll.

One male, so exceedingly close that I do not separate it.

White Swamp, May, 1939 (J. Hardcastle).

Parasphocodes vulneratus Ckll.

One female, exceedingly close, perhaps a mountain race.

White Swamp, June, 1939 (J. Hardcastle).

Parasphecodes cirriferus Ckll.

One female, typical in every character.

White Swamp, June, 1939 (J. Hardcastle).

Parasphecodes noachinus Ckll.

Females, indistinguishable from Grampians, Vic., specimens, and typical in every character.

Males (allotype) with description attached.

White Swamp, March, 1939 (J. Hardcastle).

Typical females in every character (topotypes).

Kiata, Vic., October, 1928 (C. Borch).

Grampians, October, 1928 (E. Wilson).

Parasphecodes noachinus Ckll.

Ann. Mag. Nat. Hist. (8), xiii., 1914.

Male: Length, 10 mm. approx. Black.

Head wider than long; face covered with sparse white hair; frons closely and coarsely punctured; clypeus convex, scattered punctures, a wide yellow mark with a median pointed extension upward; supraclypeal area with closer punctures; vertex rugose; compound eyes reniform; genae with sparse white hair; labrum and mandibulae black; antennal scapes short, flagellum long, black.

Prothoracic corners with dense white hair; tubercles black, with a dense fringe of white hair; mesothorax shining, with close coarse punctures, a few white hairs; scutellum shining, punctures much smaller; post-scutellum rough; metathoracic area with a sharp rim inclosing a number of large longitudinal rugae, outside of area posteriorly are numerous punctures, and a few white hairs; abdominal dorsal segments one, two and three with even large puncturing; ventral segments with scattered white hair, the second sternum having a mammiform elevation like the female.

Legs black, sparse whtie hair; tarsi black, hair slightly yellow; claws reddish; hind calcar blackish; tegulae polished black; wings dusky; nervures blackish-brown; cells: second cubital contracted at apex, third almost quadrate; pterostigma dark-brown; hamuli thirteen, strong.

Locality: White Swamp, March, 1939 (J. Hardcastle).

Allotype in the collection of the author.

Family Melectidae.

Crocisa omissa var. A. Ckll.

A male and a female, with extremely dark wings.

Woy Woy, N.S.W., December, 1935 (R. Willey).

A female, with even darker wings.

Cooma, March 28, 1918 (C. E. Cole).

Clovelly, March, 1934 (P. Whiteley).

CROCISA QUADRIMACULATA Rads.

Two females, typical. New record for State.

White Swamp, March, 1939 (J. Hardcastle).

Family MEGACHILIDAE.

MEGACHILE SERRICAUDA Ckll.

A series of males with pale ochreous—not fulvus, as in type—hair of thoracic disc not abundant. One female, taken at same time and place is probably the other sex. One male lacks the emargination at apex of abdomen.

Sydney, January, 1930 (P. Whiteley).

MEGACHILE DEANII Raym.

A female, not quite typical, since it lacks the fulvus scales about the antennae.

Observed to gather refined wax from domestic bee-hives, and to carry the wax pellet between the front legs and "chin", grasped by the mandibles.

Described from Mount Tambourine, Queensland.

For biology of this species, see "A Cluster of Bees".

White Swamp, June, 1933 (J. Hardcastle).

MEGACHILE CHRYSOPYGA Ckll. syn. M. MACULARIFORMIS Ckll.

Females, not quite typical, having black legs, scopa reddish, but it may be stained with pollen-oil. Typical leafy "nests" of three cells each, constructed in cracks of "flaggy" rock. Gathers pollen from "Tallow-wood", *Eucalyptus* sp.

White Swamp, March, 1939 (J. Hardcastle).

MEGACHILE SUBATRELLA, *sp. nov.*

Female: Length, 10 mm. approx. Black.

Head transverse, much white hair at sides of face; frons with dense coarse punctures; clypeus closely and coarsely punctured, with a median line irregular, and polished; supra-clypeal area conspicuously polished, impunctate; vertex densely punctured, a few fuscous hairs; compound eyes green; genae with long white hair; labrum black; mandibulae black, broad, obscurely dentate, coarsely punctured and channelled; antennae black.

Prothorax large, with white hair above; tubercules black, with white hair; mesothorax shining, densely and coarsely punctured, a few ochreous hairs; the large scutellum similar, and jutting over the postscutellum and metathorax; abdominal dorsal segments broadly depressed, minute lineations separating the punctures, each of which has a black hair; narrow white hair-bands on 1-5, 6 with black hair; ventral scopa white, black at apex, and sides of penultimate segment.

Legs with white hair, tarsi with golden hair on inner surface; claw segment reddish; hind calcar amber; tegulae brownish, with lineolate sculpture between the punctures; wings hyaline, nervures dark-brown, second

recurrent meeting second intercubitus (morphological third); pterostigma inconspicuous.

Locality: Inverell, N.S.W., November, 1935 (P. Stevens).

Type in the collection of the author.

Allies: *M. atrella* Ckll., described from Western Australia, and which has red quadridentate mandibulae and a different clypeus; *M. quinquilineata* Ckll., which has the supraclypeal area densely punctured.

MEGACHILE APPOSITUM, *sp. nov.* (Pl. xxiv.)

Male: Length 10 mm. approx. Black.

Head very broad; face with much long white hair; frons, clypeus and supraclypeal area densely punctured; vertex roundly developed; compound eyes with anterior orbital margins parallel, between the facets a number of short hairs; genae closely punctured, with long white hair; labrum black; the fossa is a large remarkable basin-like cavity; mandibulae rather acute, with a large triangular tooth directed down on the lower side; antennae black, flagellum red beneath, the apical segments darker and club-shaped, the subapical one somewhat flattened.

Prothorax closely punctured, long white hair; tubercles masked with the long white hair of the rugoso-punctate metapleura; mesothorax and scutellum excessively closely punctured, scattered white hair; postscutellum not so rough; metathorax coarsely tessellate, rugose at base, white hair laterally; abdominal dorsal segments black, with close punctures of a peculiar character, from each of which issues a long black appressed hair, the segments are narrowly depressed basally and apically, laterally the margins are polished amber with a short fringe of hair, one has a bowl-like depression basally, in which at the sides is a tuft of dense moss-like orange hair, the dorsal surface has dense large punctures of ordinary form, and a thin fringe of long white hair, two has a tessellate sculpture, with close large and small punctures, five with a large patch of rather long orange hair that invades the margin of four; six is black-haired and slightly emarginate; ventral segments very peculiar, being produced to thin transverse plates at an obtuse angle to the body, a dense mat of silvery white hair covers the gaster.

Legs black, tibiae and median and hind tarsi reddish; the anterior tarsi remarkable, segments one, two and three of equal length, expanded to thin cream-coloured plates with a black spot interiorly, and long fringes of golden hair posteriorly, the fourth very small, the fifth longest and extremely slender, amber; the anterior coxae with a pair of very long and fine polished-black processes clubbed at the apex; claws red, bifid; hind calcar red; tegulae obscurely red, closely punctured, with a tuft of white hair; wings slightly dusky; nervures blackish-brown, basal just short of nervulus; cells: the very long second cubital receives both recurrents just inside the intercubiti; pterostigma dark-brown; hamuli nine, of moderate development.

Locality: Botanic Gardens, Melbourne, Victoria, January, 1933 (Rayment).

Type in the collection of the author.

Allies: Approaches *Thaumatosoma duboulaii* Sm., which has simple legs and the seventh abdominal segment armed with lateral spines. The new bee plainly links up the ordinary forms of *Megachile* with the males

of this genus; the club-like apex of the flagellum not being so marked in the new species. However, to the student of comparative morphology, these intermediate forms undoubtedly demonstrate evolutionary development, and are more interesting than the typical species. The English bee, *M. willoughbiella,* has some characters of the new bee.

The specimen was netted whilst darting over the flowers of *Swainsona galegifolia,* but all the females collected from the same plant proved to be of an entirely different species; the male of which is known.

MEGACHILE TRICHOGNATHA Ckll. and its subspecies TOSTICAUDA Ckll.

Adelaide, S.A. Type locality. Four forms of this leaf-cutter are a demonstration of variation within a species, and, though the minutiae separating them may be tedious, yet the naturalist, seeking to separate one from the others, will find the characters given below of prime importance.

Lake Hattah, Vic. These differ slightly from the type, having greenish eyes, with minute hairs between the facets; a large snout-like elevation on the clypeus; flagellum dull-orange beneath; red claws; tegument of thorax shining; radial cell shorter; genae grooved; tegulae dark-apricot; legs black; margin of clypeus simple.

Broadmeadows, Vic. Specimens from here are typical in every respect.

Gunbower, Vic., var. A. of the subspecies. Blackish eyes, without hair; a smaller elevation on the clypeus; which is subcrenulate on the margin; flagellum dull-red beneath; claw-segment and tegulae half red and half black; genae grooved; tegument shining; radial cell longer.

Locality unknown, var. B. Black eyes without hair; very small elevation on the clypeus, which is crenulate on the margin; flagellum black; genae with round punctures; claw-segments and tegulae jet-black; tegument of scutellum with a minute tessellation; tarsal hair very golden; radial cell very long. Male smaller, with acute, not broad, mandibles; some red on median legs.

Mackay, Queensland. Subspecies *tosticauda.* Eyes darker, with no hairs; little, if any, elevation on the clypeus; flagellum dull-red beneath; foxy-red hair at apex of abdomen more abundant.

Adelaide, S.A. Females similar to those from Lake Hattah have been received very recently. The bees from Lake Hattah were collected by that veteran, J. E. Dixon, of the Field Naturalists' Club, Victoria.

MEGACHILE CETERA Ckll.

Two females, larger than type, tegulae pallid anteriorly (black in Swan River, W.A., specimens); recurrent nervures equally distant from intercubiti.

Woy Woy, March, 1934 (R. Willey).

Sandringham, Vic., March, 1936 (Rayment).

Both sexes on flowers of garden Asters.

Swan River, W.A., (L. J. Newman).

Bronte, N.S.W. (with nests) (P. Whiteley).

Orange, N.S.W. (P. Whiteley).

Woy Woy, N.S.W., and Windsor, Vic., March, var. *A.* Ckll. (Rayment).

Sydney, N.S.W., March, 1934 (P. Whiteley).

Megachile gilbertiella Ckll.

One female, typical in all characters.

New record for State. (Described from Cooktown, Queensland).

Woy Woy, N.S.W., March, 1934 (R. Willey).

Megachile chrysopyga Ckll.

One female, with second recurrent nervure meeting third intercubitus. This is a very stable species.

Sydney, September, 1937 (Rayment).

Megachile latipes Sm.

One typical female.

Sydney, October, 1937 (Rayment).

Megachile suffusipennis Ckll.

One female.

Cronulla, October, 1937 (Rayment).

Megachile latericauda Ckll.

One female, typical.

Albury (M. McKean).

Megachile subsericeicauda, *sp. nov.*

Further study of a male, taken with a female (described by the author, in a "Cluster of Bees", as the allotype), shows the necessity for separating it from *serricauda* Ckll. The female thus becomes the type of the new species, and the description of the male is appended.

Male: Length, 10 mm. approx. Black.

Head large; facial quadrangle longer than wide, with much fulvous hair; frons more coarsely punctured; clypeus extremely densely punctured with shorter paler hair; supraclypeal area with smaller punctures masked with fulvous hair; vertex roundly developed, uniform coarse punctures all over, a few pale hairs; compound eyes greenish in life; genae with palest straw-coloured hair (much denser in *serricauda*); labrum black; mandibulae black, wide, bidentate, a few pale hairs; antennae long and black.

Prothorax not visible from above; tubercles black, with white hair; mesothorax and scutellum densely punctured, with a few palest straw-coloured hairs; postscutellum rougher, metathorax with a tessellate area shaped like an inverted moorish dome, surrounded by coarse punctures; abdominal dorsal segments shining, coarse punctures, the broad posterior margins of one and three with a fine tessellation and depressed, but all have a fine band of pale straw-coloured hair; apex emarginate, with fine teeth like *serricauda*; ventral segments with red margins and dense fringes of white hair.

Legs black, with long white hair; anterior tarsi slightly modified as in *serricauda*, with some cream-colour anteriorly; claws red with darker tips; hind calcar reddish-amber (black in *sericeicauda*); tegulae black basally and amber, finely punctured; wings slightly smoky; nervures brown; cells: normal (fuliginous on upper half of radial in *sericeicauda*); pterostigma brown; hamuli twelve, of moderate development.

Locality: Sydney, N.S.W., January, 1933 (P. Whiteley).

Allotypes in the collection of the author.

Allies: *M. sericeicauda* Ckll., which has simple anterior tarsi; *M. serricauda,* which has pale-fulvous hair-bands on abdomen. The new species stands between these two.

Family Anthophoridae.

Asaropoda rufa Raym.

A series of fine large females, taken when "sleeping" on a grass-stalk, on which they prop themselves out horizontally. Females conforming to *A. punctata* were taken from the same slumbering group, and these may prove to be the two sexes.

Marrickville (P. Whiteley).

Anthophora adelaidae Ckll.

One female, in bad condition, but does not seem to differ from specimens taken on Rottnest Is. W.A. (J. Glauert).

Inverell, November, 1935 (P. Stephens).

Gunningbland, December (Col. not known).

Wururga, W.A., November (— O'Connor).

Gunbower, Vic., February (Rayment).

A series of males and females, quite typical.

White Swamp, March, 1939 (J. Hardcastle).

On flowers of *Plectranthus parviflorus.*

One male, quite typical.

Macquarie River, January, 1936 (P. Whiteley).

Anthophora lilacina Ckll.

One male, typical.

Macquarie River, January, 1936 (P. Whiteley).

Anthophora gilberti Ckll.

Two smaller females, but typical otherwise.

White Swamp, January 1, 1936 (J. Hardcastle).

A remarkably large female, from a plaster cell.

Maitland (Rayment).

Anthophora salteri Ckll.

Females taken from plaster cells in mortar of brick wall.

Marrickville, January, 1936 (P. Whiteley).

Anthophora cingulata Fabr.

Females and males, quite typical.

Woy Woy, February, 1935 (R. Willey).

Anthophora murrayensis, *sp. nov.* Text figure 2.

Female: Length, 10 mm. approx. Black.

Head with drab-white hair; face-marks cream-colour; frons closely punctured; clypeus with a pattern like the three prongs of a heavy trident; supraclypeal area with a bracket-shaped narrow mark; vertex covered with a mixture of black and white hair; compound eyes greenish; genae with white hair; labrum and mandibulae cream-coloured; antennae a cream line on scape, flagellum ferruginous beneath, seg. 4 palest, and a similar spot under the cream on the scape.

Prothorax not visible; tubercles black; mesothorax closely punctured with dull yellowish-white hair; on scutellum and postscutellum a few black hairs intermixed; metathorax similar; abdominal dorsal segments closely punctured, with five bands of palest-blue hair, apex of abdomen with black hair; ventral segs. with a few black hairs.

Legs with dull-white hair, hind basitarsi with black hair and a spot of light hair; claws large; hind calcar black; tegulae apricot; wings clear; nervures dark-brown; cells normal; pterostigma inconspicuous; hamuli very strongly developed.

Male: Length, 8.5 mm. approx.

The cream face-mark in the middle of the clypeus is almost a pyramid, but the apex on *lilacina* is as wide as the supraclypeal mark, which is quite different in shape.

Locality: Gunbower, Vic., February 2, 1934 (Rayment).

Type and allotype in the collection of the author.

Allies: *A. pulchra* Sm., which is definitely not *zonata* of the East. I compared this with a specimen from Formosa, identified by Meyer. The genitalia of the four bees discussed here are quite different.

ANTHOPHORA THOROGOODI, *sp. nov.* (Text figure 2.)

Male: Length, 9 mm. approx. Black.

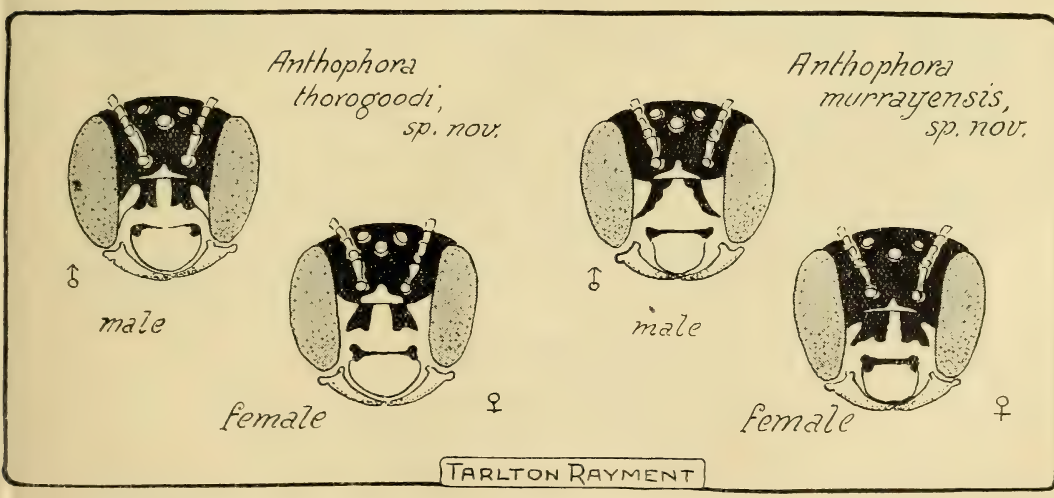


Fig. 2. Head capsules of *Anthophora thorogoodi* Rayment, and *Anthophora murrayensis* Rayment.

Head transverse; face-marks cream-coloured; frons closely punctured, white hair; clypeus cream, with two quadrangular black marks, the lower margin of which is like a fishtail; supraclypeal area with a small narrow mark; vertex with orange and black hair intermixed; compound eyes brown; genae have the palest-blue hair; labrum cream-coloured; mandibulae cream at base, reddish at tip; antennae blackish, scape with cream stripe.

Prothorax not visible; mesothorax closely punctured, with ochreous and black hair intermixed; scutellum and postscutellum similar; metathorax with dull-white hair; abdominal dorsal segments with five bands of palest bluish-green hair, basal two with ochreous tints; ventral segments with three bands of bluer hair.

Legs black, hair drab-white to ochreous; tarsi black; claws very long; hind calcar blackish; tegulae dark-amber, covered with long golden hair; wings clear; nervures dark-brown; cells: second cubital greatly contracted at top; pterostigma inconspicuous; hamuli well developed.

Female: Length, 11 mm. approx.

Head with orange and black hair intermixed; black marks on clypeus much wider, with black hair, white hair on the cream portions; supraclypeal area has a low triangular cream mark reaching clear across the black marks of the clypeus; genae with pale-blue hair below, yellowish hair above; antennae with cream line on scape.

Thorax with dense bright-orange and black hair intermixed; abdominal dorsal segments with five bands of hair, the basal two ochreous, the others palest blue; ventral segments have pale-blue hair at sides.

Legs with dull-white hair, ochreous basally; a trifle of similar hair on the basitarsi, which otherwise have black hair.

Locality: Proserpine, Queensland, March, 1937 (H. Thorogood).

Type and allotype in the collection of the author.

Allies: *A. emendata* Sm., which is larger, with a slightly different face-pattern in the female. The bees were bred from cells in the large mud "nest" of a wasp.

The species is dedicated to the collector, in appreciation of his assistance in collecting.

The position of the Australian species is very unsatisfactory in the blue-banded group, which is exceedingly difficult to classify, and no descriptions of females should be attempted in the absence of the male. I am preparing a critical Revision of the Genus, based on a study of the genitalia and the abdominal plates of the males, which seem to possess reliable characters, and I find that the knee-plates of the females offer some possibilities.

Division Xylocopiformes.

Family Ceratinidae.

Exoneura montana, *sp. nov.*

The new species is close to *E. hamulata* Ckll. and two other bees, and since there is some doubt about the male of *hamulata*, I append the following synopsis.

E. montana: Large females, 9 mm. Face-mark like *hamulata*, but

fading; eyes converge slightly below; legs like *hamulata,* but red, much lighter, with black hair on hind tibiae; wings paler.

Smaller females: 7 mm. Face-mark brighter; base of abdomen with a black mark like a heavy T, the cross-bar on seg. 1, and the shaft on seg. 2. From same brood.

Male: Length, 7 mm. Cream face-mark nearly an equilateral triangle; antennae red beneath; face shining; wings clear, nervures light-amber.

E. hamulata Ckll.: Females, 7-8 mm. Cream narrow face-mark hooked at top; eyes do not converge; legs dark-red, with ferruginous hair on hind tibiae; wings darker, nervures dark-brown.

Male: Length, 7-8 mm. Face-mark like female; face dull; wings suffused, nervures dark-brown. Specimens from Grampian Hills (Western), do not differ from those from Emerald Hills (Eastern) Victoria.

E. bicolor Smith: Length, 6-7 mm. Face-mark narrower; eyes converge below; orange hair at apex of abdomen; antennae darker.

Male: Length, 6-7 mm. Two cream-coloured lateral face-marks in addition to the one on clypeus.

E. robusta Ckll.: Length, 6-5 mm. Seg. one of abdomen black; antennae and legs black, or only obscure red.

Male: Length, 6 mm. Face entirely black.

Type-locality of *montana,* White Swamp, Macpherson Range, 1938 (J. Hardcastle).

Cotypes in the collection of the author.

EXONEURA FLORENTIAE, *sp. nov.*

Female: Length, 6 mm. approx. Black, red abdomen.

Head shining, a delicate sculpture; face-marks confined to two minute leaf-shaped lateral creamy marks; frons deeply excavated laterally down to labrum; clypeus convex, suffused with reddish-amber, a delicate sculpture and minute punctures; supraclypeal area dull, a fine carina above not reaching the median ocellus; vertex with a few dusky hairs; compound eyes large and convex, converging below; genae large, with sparse yellowish hair; labrum large, reddish-amber; mandibulae black, reddish subapically; antennae with red scapes, flagellum dark-amber beneath.

Prothorax not visible from above; tubercles blackish-amber, with a fringe of white hair; mesothorax shining, a delicate sculpture, almost impunctate; scutellum similar, a few pale hairs; postscutellum margined with amber; metathorax with a large area having a scale-like sculpture; abdominal segments clear light-reddish approaching orange in colour; apical segments tessellate; ventral segments orange-red.

Legs clear orange-red, anterior pair somewhat darker; tarsi and claws light-red; on the posterior tibiae light and dark hair is intermixed; hind calcar simple, light-red; tegulae polished, dark-brown; wings dusky-red, very irridescent; nervures dark-brown; cells normal; pterostigma dark-brown; hamuli weak, five.

Locality: Black Sands, Yarra Valley, Victoria, October 16, 1936 (Md. E. F. d'H. G.).

Type in the collection of the author.

Allies: *E. albolineata* Ckll., which has a yellow clypeal mark, black at base of abdomen, and legs black basally. *E. hackeri* var. *incerta* Ckll., which has dusky bands on abdomen, and black scape; *E. angophorae* Ckll., which has yellow clypeal stripe and black hair on hind tibiae.

On flowers of Heathy Parrot-pea, *Dillwynia ericifolia*.

The species is dedicated to Md. Elsa Florence d'Henzil Gosewinckel in appreciation of her conscientious assistance in collecting.

Family CERATINIDAE.

EXONEURA BACULIFERA Ckll.

One female, quite typical. Another with a black basal patch on abdomen.

Woy Woy, N.S.W., February, 1935 (R. Willey).

Gladesville, October, 1936 (not quite typical) (Ian Dutton).

EXONEURA HAMULATA Ckll.

Two females, quite typical in every character.

Gosford, 1933 (H. Cambourne).

One male, almost entirely black. (Specimens from the Grampians, Vic., are redder.)

Woy Woy, N.S.W., February, 1935 (R. Willey).

EXONEURA PLORATULA Ckll.

One female, quite typical.

Woy Woy, March, 1935 (R. Willey).

EXONEURA PARVULA Raym.

A series of females, quite typical, but one has black spots only on basal segment of abdomen. Smallest only 4 mm. in length.

Woy Woy, N.S.W., March, 1935 (R. Willey).

The several females are indistinguishable from specimens collected at Marysville, Vic., by myself. These have some resemblance to *E. brisbanensis*, Queensland.

EXONEURA ANGOPHORAE OBLITERATA Ckll.

One female.

Sydney, October, 1938 (Rayment).

ALLODAPULA SIMILLIMA (Sm.).

One female, indistinguishable from Bribie Is., Queensland, specimens (H. Hacker).

Gosford, April, 1933 (H. Cambourne).

White Swamp, May, 1939 (J. Hardcastle).

These typical forms were taken on flowers of *Lomatia* sp.

The complete biology of this species is awaiting publication.

Family XYLOCOPIDAE.

XYLOCOPA (MESOTRICHIA) BRYORUM (Fabr.).

Females, typical in all characters.

Observed to emerge from galleries in Native Orange Tree, *Capparis Mitchelli.*

Narrabri, February, 1934 (H. H. Hardy).

Townsville, Queensland, May 5, 1934 (Col. not known).

Tarringa, Queensland (Col. not known).

Woods Reef, Barraba, N.S.W. (Rayment).

Taken on flowers of garden Wisteria.

Tamworth, N.S.W., March 3, 1932.

Cairns, Queensland, May, 1934 (J. Mansky).

Subsp. DIMIDIATA Lepel.

Cooktown, Queensland, June 27, 1906 (T. Thorn).

LESTIS BOMBYLANS Fabr. var. VIOLACEA.

Typical females.

Barraba, October, 1932 (P. Stephens).

Bingera, April, 1938 (J. Dunstan).

White Swamp, March, 1939 (J. Hardcastle).

Family APIDAE.

Subfamily MELIPONINAE.

TRIGONA CARBONARIA ANGOPHORAE Ckll.

Typical workers (collected from blossoms of fruit trees).

White Swamp, November, 1938 (J. Hardcastle).

TRIGONA CARBONARIA Sm.

A number of workers, quite typical.

A "swarm" observed issuing from a cavity in a tree as a thick, fast-moving "ropy" spiral, having a diameter of eight inches.

Narrabri, February, 1934 (H. H. Hardy).

EXPLANATION OF PLATE XXIII.

1. Adult male, *Sphaerhylaeus procurvus* Rayment. Note how the dilated bases of the antennae project out in front of the eyes.
2. Front view of the head-capsule showing the globular scapes, the emarginate compound eyes and the yellow lower half of the "face".
3. Genitalia of the male.
4. Small long-oval labrum.
5. Mandible is bidentate, but long and narrow, not wide and short as in Gnathoprosopis.
6. Digging spur (calcar) of the hind leg is finely spined.
7. Wing-hooklets (hamuli) are very few and weak.
8. Antenna-cleaner (strigil) of the front leg.
9. Median legs have simple claws but those of the hind legs are bifid.
10. Pattern (striato-punctate) of the mesopleura.

11. Pattern of metathorax is only striato-tessellate.
12. Punctures of the abdomen are few and small.
13. Disc of the metathorax has dense and coarse puncturing regularly disposed.

PLATE XXIV.

1. Adult male, *Megachile appositum,* Rayment.
2. Apical ventral segments.
3. Mandible.
4. Tarsal segments of anterior leg.
5. Coxae, with slender process.
6. Basin at base of abdomen with two conspicuous hair-spots; note the small oval depressions on the margin.
7. Posterior view of the head-capsule showing the great fossa with the labrum folded over the mentum.
8. Inner surface of three tarsal segments of the anterior leg; a, b, c, three types of spines.
9. Sculpture of second abdominal segment.
10. Sculpture of first abdominal segment.
11. Sculpture of the metathorax is tessellate, but narrowly rugose at base.

REVIEW.

An Australian Bird Book. By J. A. Leach. Revised by Charles Barrett. 8th Ed. 1939. Whitcomb & Tombs, Ltd. Melbourne and Sydney. 8/6.

To Australians generally, and to Victorians in particular, the name of Dr. Leach is familiar as a guide to the beautiful and interesting birds of this Continent. As a youth, and in the early days of his service in the Department of Education of Victoria, Leach was a keen student of wild life, and especially of the birds. With advancement in the service he gave more time to nature study, and made his hobby a sure means for promotion. By open-air lectures and addresses to students, and by publication of his now memorable Australian Bird Book, he proved his value to the educational system, eventually being appointed Secretary of the University of Melbourne Extension Board.

This new edition, published nearly ten years after his early and lamented death, comprises the "lecture" which he placed as a sort of running commentary at the base of each page of the original editions of his "Book", but now removed to the end of the systematic list of birds, and slightly added to by the present editor, Charles Barrett. The coloured representations of 178 species are from the original plates, and, though rather small for ready identification in some instances, at least give a general idea of the form and colour of our birds. Mr. Barrett has added a number of half-tone illustrations from his own and other photographs, all of which add to the attractiveness of a most useful and comparatively cheap guide to the nature student. The "jacket" depicts a charming study of our old friend the Kookaburra in colour and contemplative mood.—A.F.B.H.

A NEW GENUS AND SPECIES OF BIRD OF PARADISE.

By J. R. Kinghorn, C.M.Z.S.

(By Permission of the Trustees of The Australian Museum.)

Taeniaparadisea, *gen. nov.*

Bill straight, normal as in *Astrapia* and *Pseudastrapia*, but the culmen is only 25 mm. in length. The feathering of the forehead extends onto the culmen forming a dense tuft of velvet pile. Exposed portion of culmen only 10 mm. in length. Tail graduated, the rectrices with sharp-pointed triangular tips. In the male the two central rectrices are extremely long and narrow, being ribbon-like and three times as long as the head and body. These rectrices are white with a black and pointed tip. It is by these ribbon-like feathers that the bird can be at once distinguished from any other bird of paradise.

Taeniaparadisea macnicolli, *sp. nov.*

McNicoll's Ribbon-tailed Bird of Paradise.

(Plates xxv.-xxvi.)

Description of male: Plumage above and below, velvet-like, black with a metallic brass-green tinge on the mantle and back, changing into purplish and blue on the rump and upper tail coverts. Tail graduated, the rectrices all pointed; brown in colour, with an indistinct purplish sheen under favourable light. The two central feathers are ribbon-like, three times as long as head and body, and are white with a black pointed tip. The top of the head, frontal tuft, nape and underside of the throat bright metallic green shot with blue. These metallic feathers are not so scale-like as in other closely related species. A black, green-tinged velvety tuft extends well along the culmen, and a similar one about half way along the lower mandible. There is a small but definite patch of metallic blue-green on the bend of the wing which changes to violet on the lesser under-wing coverts. There is a narrow band of fiery copper colour across the breast. The upper breast is metallic like the back. Abdomen with a very dark green tinge over velvety black. The wings are brown with an indistinct purplish gloss. The sixth and seventh primaries are equal and longest, the first falling short of the tip by about 68 mm. Colour of eye unknown, but the bill and legs are blackish. The measurements of the Holotype and Paratypes are as follows:—

	Culmen	Tarsus	Wing	Tail	Total length		White tail plumes.
Holotype. 0.37058 ..	25	44	176	120	320	approx.	920
Paratype. 0.37059 ..	26	46	177	116	320	,,	820
Paratype. 0.37060 ..	25	45	175	120	320	,,	920

Owing to the density of the feather tuft on the culmen, this measurement is indefinite.

Female: The female is reported as being a brown bird with a short tail. Nothing more than this is known.

Affinities: Whilst I have compared *Taeniaparadisea* either with descriptions or specimens of several species of *Astrapia, Parotia, Lamprothorax, Paradigalla* and *Epimachus,* in order to calculate the value of its various characters, it cannot be regarded in any way as closely related to, or connecting any two of them. Perhaps its nearest ally is *Astrapia splendidissima.*

Quite apart from the extraordinary ribbon-like tail of *Taeniaparadisea,* the velvety feathers of the mantle are quite 45 mm. in length as against an average of about twenty-five in the genera mentioned. A glance at the form of the tail will show that, whilst the rectrices are pointed, they are shaped more like those of *Epimachus ellioti* than of any other species, whilst the tuft on the culmen resembles that of *Parotia duivenbodei. Astrapia splendidissima* has much the same general colouring, though much brighter and more striking, but *Astrapia* has a squarish tail with rounded tips. It will be seen, therefore, that *Taeniaparadisea* is an unique bird in more than one respect, and must be placed in a genus by itself.

Habitat: The highlands of Central New Guinea in the Hagen-Sepik District, 8,000 to 10,000 feet above sea level.

Described from three specimens collected by Messrs J. L. Taylor and J. R. Black, leaders of the Hagen-Sepik Patrol, and presented to the Trustees of the Australian Museum by the Administrator, Sir Walter Ramsay McNicoll, after whom the species is named.

Notes: The following field notes were supplied by Mr. J. L. Taylor, Assistant District Officer, who, with Mr. J. R. Black, obtained the birds, and who supplied the accompanying map showing the exact location, or area in which the species occurs.

"Bird of Paradise (Long white tailed species).

This bird was observed in the forested ranges of the main cordillera west and north west of Mt. Hagen between longitude 143 degrees 30 minutes east, and 142 degrees 30 minutes east, on both sides of the Strickland (Fly)-Yuat (Sepik) watershed. It is possible that the bird will be found further west in the Star mountains of Dutch New Guinea. The species appears to be confined to altitudes between 8,000 and 10,000 feet above sea level, and is more numerous at 9,000 feet than at any other height.

There are not very many of them but one meets them here and there in the high forest. They make a clicking or hammering sound something like a pneumatic riveter at work, and appear to have some difficulty in flying; the long tails being an encumbrance. Their flight is slow and jerky, and over short distances only. In display, they jump from branch to branch raising the tail slightly.

The female, speaking from memory, is a light brown in colour, with a shorter tail, perhaps only six inches in length.

The local people (natives) know the bird as Yaka Yan-gi; yaka meaning bird.

In the accompanying map, the shaded portion indicates the area in which the species was observed."

DESCRIPTION OF PLATES XXV AND XXVI.

Plate xxv. *Taeniaparadisea macnicolli* Kinghorn. In oval, Bird without tail feathers. In background complete figure of bird circa 1/3rd natural size. Lilian Medland, del.

Plate xxvi. Map showing by shading locality where type specimen was collected.

AUSTRALIAN COWRIES: PART II.

By Tom Iredale.

(*By Permission of the Trustees of the Australian Museum.*)

(Plates xxvii.-xxix.)

Since the publication of the first part (Vol. viii., pp. 96-135, 1935), there has been continued progress with our information regarding Cowries, from intensive collection in Australia, and from the publication of a complete resumé of the Cowries of the world gained from study of European Museum collections alone. This resumé has appeared in the Proceedings of the Malacological Society of London (Vol. xxiii., pp. 119-231, 1938-39) under the title of "Prodrome of (sic) a Monograph on Living Cypraeidae", by Drs. F. A. & M. Schilder. Obviously there must appear many discrepancies in results achieved by these very different methods of approach, and attempt at reconciliation is here undertaken.

The Drs. Schilder (husband and wife) have been working on dead Cowry shells for almost twenty years, and have examined about 60,000 specimens from 2,200 localities, about eighty (80) public and private collections being searched, while the literature, extending to some 2,500 papers, has been catalogued. Such a mass of information is now made available to all workers, and nothing but praise must be given to the authors for this excellent research. This must be emphasized as otherwise my many criticisms may be misunderstood.

The emendations now offered are mainly the result of local field experience, and are all intended to be constructive, as the basis prepared by the Schilders is a very complete foundation. My own taxonomic knowledge enables the suggestion of some alterations, but the chief purpose of this part is the recording of new facts gained in the field. For most of these I am indebted to Messrs. H. Bernhard, A. A. Cameron, C. F. & J. Laseron, and H. S. Mort for local assistance; to my colleague, Mr. G. P. Whitley, for material from that difficult locality, Shark's Bay, Western Australia; to Mr. Melbourne Ward, the initiator of the earlier paper, who has been very energetic procuring a fine collection from Western Northern Territory; and to the Rev. and Mrs. W. Chaseling, who have made large and valuable collections about Yirrkala, Eastern Arnhem Land, Gulf of Carpentaria. These last two collections fill in the only lacunae on the coast of Australia, thereby paving the way for a List of the Marine Mollusca of Australia, a desideratum hitherto impossible of accomplishment.

I am continuing these notes in the order of the previous paper, but the Schilders have utilised a somewhat different arrangement, and in the next part I may attempt adjustment as some appears necessary in both cases.

For a couple of centuries, Cowries have been the delight of amateur shell-collectors, and their varied vivid coloration has caused the nomination of very many colour-varieties. The Schilders have catalogued 165 species only which they divide into geographical races and subraces, altogether ignoring the abovementioned colour variations. They have, however, endeavoured to make use of some of colour-varietal names for these geographical races with confusing effect. From experience, it is suggested

that many of the races be regarded as species, and the subraces as subspecies, and a still better picture of the Cowry world will be prepared.

Dealing with Australian Land Shells, I pointed out that ecological forms varied with climatic conditions, and that ecomorphs might be recognised as distinct from subspecies geographically so determined. Ecomorphs can only be separated by knowledge of ecological conditions, and generally these are unknown save to the field worker. It is difficult to recognise ecomorphs under marine conditions, but the Schilders have, unfortunately, introduced a term ecotype for a recurrent individual variation, not an ecological form.

Probably the Schilders' ecotypes sometimes represent distinct species, sometimes merely individual aberrations. This seems to have been realised by the Schilders, as in their final review they indicate "superspecies" as being equivalent to some of their species, and this certainly appears to be the case.

Notes of animals of Cowries collected at Little Manly and Vaucluse in the winter of 1895 are here added through the kindness of Dr. G. A. Waterhouse, who has presented the notebook kept by his mother at that time to this Museum.

Zoogeographical Divisions.

Although Australian zoologists have determined natural geographic limits for the distribution of our fauna, the Schilders have proposed a very superficial and artificial separation, which is comparatively useless. Thus we know that the marine fauna of Queensland is divisible into two, a mainland and a coral reef series, for which the names Banksian and Solanderian are in use. We further know that marine animals with free swimming larvae extend their ranges so that Cowries have a wider range than sedentary molluscs. Hence it is obvious that the Solanderian Cowries will occur not uncommonly along the Banksian stronghold, and even extend southward into the Peronian area. Instead of accepting these facts the Schilders have created a "Queensland Region", which they humorously separate into four, North, South, East and Central, the East being Lord Howe and Norfolk Islands, the South being New South Wales, the Central being South Queensland, and the North being Mid Queensland, North Queensland being named West Melanesia. Such a negation of common correct terms is inadmissible. This misusage of divisions and names is further emphasized by the fact that the same series of species is named in each division. Quaintly enough the Schilders have used the name Dampierian Region for the North and North-west Australian series, but here again a useless separation into East, Central, West and South is given, especially as there were comparatively few records.

"These lists of faunas should replace all earlier catalogues as they critically exclude evidently incorrect indications." On account of their unwise hyperdiscrimination of areas, 115 being cited, the lists are of little more value than the earlier ones, the artificiality of the areas negativing their recognition. This must be the case always when attempts are made to discuss geozoological matters without knowledge of the regions concerned.

This obsession that every Region, however homogeneous the faunula may be, must be divided into four or five, has led to the nomination of a South Australian Region, whereas we use the names Flindersian and Peronian, for the South & South East. Having eliminated the Peronian, north New South Wales is called South Queensland, and south New South Wales

is regarded as east South Australia, while Tasmania becomes south South Australia. A curious commentary is that west South Australia is really south Western Australia, but marking Esperance as the artificial division, the Cowries from deep water in the Great Australian Bight in Western Australian waters become allotted to South Australia. Such contradictory terms only confuse the issues and certainly do not advance our knowledge in any sense.

Dampierian Cowries.

The Schilders have accepted the Dampierian Region indicating four divisions, East for the Gulf of Carpentaria commenting "We have provisionally united this area with N.W. Australia, as we do not know any sufficient population of Cypraeidae from the Gulf of Carpentaria"; Central from Port Essington to C. Jaubert; West from Port Walcott to Exmouth Gulf; while South is from Shark's Bay to Geraldton. The Dampierian Region is an indivisible entity, the species ranging from Torres Straits to Shark's Bay, one or two straggling southward to Cape Leeuwin. There is a curious little endemism present, especially notable in the case of *Zoila decipiens*. The Schilders have listed from N.W. Australia thirty-seven species, including *onyx* which does not occur; moreover they have recognised the distinction of such species as *helvola, caputserpentis, moneta, subviridis, isabella,* etc., while rejecting others which appear to show more differences as *poraria, pyriformis,* etc.

This note is, however, to record a series received from Yirrkala. Eastern Arnhem Land, the western side of the Gulf of Carpentaria, the locality whence the Schilders had no information. Subspecific names are not here used as in most cases the Yirrkala species agree with the Torres Straits' forms. The species determined are *Arabica arabica, Leporicypraea mappa, Lyncina vanelli, Ponda carneola, Mystaponda vitellus, Talparia talpa, Basilitrona isabella, Pustularia cicercula, Erosaria erosa, Erosaria tomlini, Erosaria metavona, Paulonaria macula, Evenaria asellus, Evenaria hirundo, Evenaria punctata, Palmadusta clandestina, Palmadusta bizonata, Gratiadusta walkeri, Solvadusta subviridis, Blasicrura rhinoceros, Palangerosa cylindrica, Erronea nimiserrans, Erronea caurica,* with half a dozen undetermined species. It will be noted some common Cowries are missing and that this is merely due to local ecological conditions, and such might be plentiful elsewhere in the Gulf.

It may be added that the very complete Lists provided by the Schilders may be supplemented. Oliver (Trans. N.Z. Inst., Vol. xlii., 1914, p. 126, July 12, 1915) has recorded from the Kermadecs *Cypraea caputserpentis, carneola, isabella, erosa, poraria* and *flaveola* (= *tomlini*), one of the very few records overlooked by the Schilders.

The Schilders named Lord Howe Is. and Norfolk Is. as Queensland East, and listed ten common species. To these may be added *Arabica arabica, Lyncina vanelli, Cypraea tigris, Basilitrona isabella, Nuclearia nucleus, Erosaria poraria, Erosaria helvola, Erosaria tomlini, Paulonaria fimbriata, Paulonaria microdon, Evenaria asellus, Evenaria kieneri, Palmadusta clandestina* and *Erronea caurica*. For this Region the name *Phillipian* has been introduced and this is preferable, as the islands are distinctly not appanages zoologically of Queensland, but the former is definitely an outlier of New Caledonia, i.e., the Montrouzierian Region, though of course the Cowry fauna would not show any exact relationship in either direction.

Superspecies, Species, Races and Subraces.

The Schilders have attempted a systematic reorganisation of the group, eliminating the very numerous colour varieties and aberrations, and separating the species into geographical races, which are commonly called subspecies. In their zeal for subdivision of every species they have utilised factors of such variable value that in many cases specimens cannot be recognised by any of their features. It is therefore useless to indicate the subspecies in many cases, and though I am prejudiced in favour of geographical subspecies I am unable to accept, at present, their discrimination in the cases of many of the common species. This is due to their lumping of many well defined minor series to form a largely distributed subspecies, the features of these minor series negativing each other in the larger group, and thus minimising the recognisable value of the latter. Unfortunately the Schilders have overlooked the very important item of type designation, which is absolutely necessary in the usage of geographical races. In the first part I designated some type localities as indicated by the references and these must be accepted as long as they are in accordance with the rules which govern animal nomination. In order to clarify the position I herewith designate the type localities that concern the Australasian Ccwry Fauna, and as half the total number of species recognised throughout the world occur hereabouts this is most important. Curiously when they introduced new subspecific names the Schilders omitted such designation. While they rejected all colour varieties the Schilders have attempted to use names given to such in a subspecific sense. While this is praiseworthy it is unfortunately technically impossible, and in this direction revision is necessary.

I therefore designate type localities as follows:—

Lyncina vanelli Linné. No locality = Ceylon.
Erosaria eburnea Barnes. China, error = Fiji Is.
Cribraria gaskoini Reeve. No locality = Hawaiian Isles.
Bistolida stolida Linné. No locality = Ceylon.
Paulonaria beckii Gaskoin. No locality = Philippines.
Paulonaria fimbriata Gmelin. No locality = Mauritius.
Evenaria contaminata Sowerby. No locality = Amboina.
Evenaria hirundo Linné. No locality = Ceylon.
Evenaria kieneri Hidalgo. No locality = Madagascar.
Evenaria punctata Linné. No locality = Mauritius.
Evenaria atomaria Gmelin. No locality = Amboina.
Palmadusta humphreyii Gray. No locality = Amboina.
Palmadusta lutea Gronow. No locality = Ceylon.
Palmadusta ziczac Linné. No locality = Amboina.
Gratiadusta pyriformis Gray. "New Holland" = Ceylon.
Solvadusta subviridis Reeve. No locality = North Queensland.
Blasicrura quadrimaculata Gray. No locality = Amboina.
Palangerosa cylindrica Born. No locality = Amboina.
Erronea caurica Linné. No locality = Amboina.

Zoila episema, *sp. nov.*

(Plate xxvii., figs. 3-4.)

Mr. B. C. Cotton, Conchologist, of the South Australian Museum very generously forwarded me some of the rare Cowries from their collection, and I have to thank him and the Trustees of the Museum for this opportunity of recording some very interesting facts.

In the Proc. Linn. Soc., N.S.W., Vol. iv., p. 187, pl. 15, figs. 1-2, 1889, Cox figured a very beautiful shell said to have been picked up alive at Cape Naturaliste, South-west Australia. Although noting its superficial resemblance to *thersites*, Cox concluded it was a variant of the rare North Western *venusta*. It was acquired by Sir Joseph Verco, and is now before me. It is very similar dorsally to *thersites*, but has a white base, and appears to be the Western specific representative of that South Australian species. Cox's description and figure are good when compared with *thersites* alone, and the erroneous assumption of alliance with *venusta* is rejected. I have compared it with many subadult *thersites*, but it does not agree, and cannot be regarded as an aberration. The Schilders have named the Esperance shells recorded by Verco as a broad form of *friendii* (Pl. xxvii., figs. 1-2) and thereby associated the two distinct species *friendii* and *thersites* as one species, which they very definitely are not, the present species proving that.

MAURITIA MAURITIANA Linné.

When I gave the history of the occurrences of this species in Australia, I overlooked a Western Australian record. Mr. J. J. Bailey had received from Rowley Shoals, North-west Australia, specimens so determined, and a couple were presented by him to this Museum, and are small stunted shells of this species. Nearly fifty years ago, Lea (Proc. Linn. Soc. N.S.W., Vol. xix., p. 708, 1895) recorded *mauritiana* from this State as having been taken alive some years previously at Long Bay, near Sydney. On account of the time doubt, this record was rejected, but Mr. A. A. Cameron wrote me that a living one had been taken on the reef of the Sondon River, northern New South Wales, and later procured the shell for this Museum. It is a beautiful dark coloured full grown shell, and thus *mauritiana* takes its place in our local faunula. Re-examination of Lea's specimen shows it to be an immature, and his record may also be now accepted, as such immature shells are not commonly met with in commerce.

By means of mathematical formulae and intensive research the Schilders have separated this and many other Cowries into races, but their diagnostic characters are of little value at present, and until series available confirm them the racial names are not worth recording. This remark appears to apply to the following common species as regards Australia: *Mauritia mauritiana, Arabica arabica, Arabica scurra, Leporicypraea mappa, Lyncina vanelli, Ponda carneola, Mystaponda vitellus, Cypraea tigris, Talparia talpa, Arestorides argus, Basilitrona isabella, Nuclearia nucleus, Ravitrona caputserpentis* and *Erosaria erosa*. It is possible that subspecies may be recognised by the characters of the animals as in the case of *carneola*, but this will be a matter of time. With regard to *L. mappa* the Schilders record the typical race from "N. Australia" and use *viridis* Kenyon, a valueless colour varietal name for a Melanesian race said to occur in N. Queensland. So far the few specimens seen from N. Queensland have differed notably, while N. Australian specimens (from Yirrkala, Northern Territory) show even more variation. As regards *Lyncina vanelli* (= *lynx* olim.) the variation is so great that all attempt at differentiation has failed. From small places colonies of similar shells are commonly received, and at first sight these appear to show geographic significance, but almost at once additional specimens negative the suggestion. Thus the Schilders have used *caledonica* based on a New Caledonian specimen for all Pacific shells, but colonies from the New Hebrides are all small, stunted, crassate shells with a very pronounced blue wash, while specimens from the Paumotus are

large, thin and pale brown, the blue wash missing. As regards the basal carina, in the former it is very pronounced and sharp, in the latter it is ill marked and unnoticeable.

The genus Arabica.

(Plate xxviii., figs. 1-6.)

The Schilders have given a revision of this group allowing seven species, *scurra, eglantina, grayana, arabica, histrio, maculifera* and *depressa* with many subspecies.

With a good intention of utilising old names they retain names that should be rejected, and in this connection rectification is necessary. The matter is too complex to discuss at present, but they have erred in using my *westralis* for an Eastern race of *arabica,* and admitting *histrio* in West Australia. My *westralis* was proposed for the West Australian shell they record as *histrio.* It is probable that the Eastern shells may include representatives of *westralis* and also of *perconfusa,* and that these may be separated by animal features.

Mr. H. Bernhard collected a large shell 71 mm. long by 43 mm. broad at South Keppel Is., Mid Queensland, and described the animal thus: "Dark blackish brown, transparent mantle edges, shell visible through it; appeared to have raised lumps like warts but no filaments. Mantle base dark blood red, top of foot same colour as top of mantle". The shell looks like a large *perconfusa* and may be the eastern form of that species. For future reference, figures of the types of *westralis* and *perconfusa* are here appended. It may be recalled that the *"perconfusa"* style is well known from New Caledonia under the name *eglantina.*

The Schilders have separated three subspecies under *scurra,* the typical one being regarded as the Mauritius form, although I have designated Amboina, while they use *indica* Gmelin for the Amboina race which they tentatively allow to reach N.W. Australia, and then utilise *retifera* Menke for an East Polynesian race. The last name has been overlooked by Sherborn as by myself when we collated the Malsburg Catalogue, and in 2nd edition of the Synopsis it appears as a nomen nudum for a var. under *arabica.* In any case it cannot be used for a East Polynesian race, and at present the few specimens show so much variation that no stable features have been determined. However, according to the Schilders' formulae, the local shell has fewer teeth, a shell from Lady Elliot Island, Queensland, sent me by Mr. H. W. Hermann, of 40 mm. length, has only 28 columellar and 33 labial teeth. To maintain interest this may be named *E. scurra antelia* subsp. nov. (Pl. xxviii., figs. 5-6), and it may be noted that a West Australian specimen is narrower and has more teeth, while one from Samarai is slightly broader with similar teeth. This species is represented by single specimens mostly, whereas its congeners occur numerously and might even be called gregarious.

Ponda carneola Linné.

The Schilders separate this species into four races, allowing the typical race to range from Amboina (the type locality) into North-west Australia ("and Geraldton?"), and using *propinqua* Garrett for the "Botany Bay" race, reaching there from the Central Pacific. I observed that the animal of the Queensland shell was black, and that the animal of the Tonga Tabu shell had been so described. I have come across a record by A. Adams that

the animal in the East Indies was red, with numerous opaque, oval, white spots.

As *propinqua* was named from the Paumotu and Society Islands I designate the former as the type locality, and distinguish the local form as *Ponda carneola thepalea* subsp. nov. The shell reaches a large size, 65 mm., and thereabouts, the average size recorded by the Schilders being 33-35 mm., specimens of 74 mm. being regarded as giants and made a different species. The southern shell is very similar to the typical one, but seems to have fewer teeth and comparatively being a little broader. A small adult specimen, 36 mm. long, collected by Mr. A. A. Cameron at Heron Island, Capricorn Group, differs in the animal being black, mottled with grey, slightly more black than grey, foot of a fawn colour.

[PONDA SCHILDERORUM *nom. nov.*

Gray (Zool. Journ., Vol. i., p. 147, March, 1824) described and figured (pl. vii., fig. 6, pl. vii., fig. 6), *Cypraea arenosa,* from unknown locality, the shell being in the "Mus. Sowerb." A little later, in the Conch. Illus., Sowerby gave "Pacific Ocean, Annaa", as the habitat. Although the name has been used commonly since it is invalid, as Dillwyn, the year before, had published Solander's name of *arenosa* (Index Lister Hist. Conch., p. 33, 1823). No available synonyms of Gray's species exist, so I have great pleasure in introducing the above substitute, as a mark of my respect and thanks for the wonderful mass of research the Schilders have published on this group, an unrivalled boon to all students.]

CYPRAEA TIGRIS Linné.

The colour varieties of this species have been named, irrespective of locality, and these names are valueless for geographical usage. Some of the most luridly coloured forms are due to disease, but I found a series of pallid ones showing that in some cases the paleness was also disease caused. The Schilders have recorded three races, restricting *tigris* to the East African area correctly; using *pardalis* Shaw for another race with a range of Central Malaysia to Japan, etc., but this name is invalid, being a pure substitute for *tigris* from objection to the name *tigris* for a *spotted* shell; the third race is regarded as a Central Pacific one ranging to Hawaii and Gambier Is., and occupying the Queensland coast; for this race the Schilders have selected *lyncichroa* Melvill, a varietal name introduced for a coloured phase without any locality. There is no valid reason for the usage of this name, as any one of the five prior colour-names given at the same time is equally as applicable, and technically none is available. There is too much variation seen at present to allow distinction of subspecies.

Obviously *lyncichroa* is based upon the common diseased form which can be linked up with *flavonitens* and *russonitens,* and also *zymecrasta.* A series, from the Great Barrier Reef, shows all these variations along with an excellent series of *hinnulea*-like specimens.

THE GENUS PUSTULARIA.

This genus has been divided into three species with *mariae* and *tesselata.* The last addition is one of the most extraordinary of their actions, as no species is more distinct than this one, which has also a valid generic name, *Tesselata* Jousseaume. For *mariae* I proposed *Annepona,* giving *cicercula* as type of *Epona* H. & A. Adams, as reported by Melvill and others,

but I was unable to cite original type designation. I have a note that Weinkauff in 1881 designated *annulata* = *mariae* as type of *Epona*, and if this be verified, *Epona* must displace *Annepona*. I recorded *P. cicercula* and *P. globulus* from Queensland, the latter only from Western Australia. The Schilders have rejected *cicercula*, and in place included *Pustularia bistrinotata mediocris* (= *cicercula* Reeve, 1846), but Reeve's species came from the Is. of Annaa, and that island is selected as type locality. At the same time *P. bistrinotata sublaevis* was introduced for the East Polynesian race, and Kiener's figure of a Timor shell cited as illustrative, although Timor is included in the range of the typical *bistrinotata*.

As three species do occur in our seas these matters will be later adjusted.

Ravitrona caputserpentis Linné.

I have been unable to distinguish races of this widely spread species, though the local form always impresses by its very dark coloration. Collections from various localities show so much variation that no stable character has been found. Yet the Schilders have separated seven races, even differentiating a West Australian form from the North-west one, and then an East Australian one as well. If these races can be confirmed later, their nomination must be reviewed as that used by the Schilders is definitely incorrect, their usage of *caputanguis* Philippi for the eastern one having no basis in fact. The name used for the North-west Australian species is also inacceptable. An animal collected at Long Reef, north of Sydney, N.S.W., by the Laserons is thus described: "Mantle greenish with a dense covering of mauve filaments with three to five branches. Foot pale ashgreen densely speckled with black towards border. Siphon pale green with white specks, fringed. Tentacles very pale heliotrope".

Mrs. Waterhouse described a Manly animal as "very dark chocolate, the mantle covered with tufts of brown", while A. Adams noted that in the East Indies the animal is a rich green-brown.

Mr. H. Bernhard found the colours intensified in a specimen he collected at Long Reef, the filaments being dark crimson and the tentacles red. The mantle was greenish overlaid with blackish dots and splashes, edge of mantle dark brown.

Erosaria erosa Linné.

(Plate xxvii., figs. 5-6.)

The Schilders have separated this species into six races and have used *purissima* Vredenburg for the Australian shell, which they diagnose "aperture dilated throughout and very wide in front . . . teeth more distant as they are less thickened. . . " There is too much variation seen in this locality to delimit a race, as in some places the aperture is very narrow and the teeth very thickened; some shells are large, some small, with every feature inconstant. No pure white shell has ever been seen, and Vredenburg's specimen, although labelled Moreton Bay, did not come from that place. To make matters worse, the Schilders have utilized a series of varietal names given to Melvill for their so-called geographical races. Thus Melvill introduced *phagedaina* for a variety "without the vivid lateral blotches" and *chlorizans* for a dwarf form with "lateral blotches conspicuous". The Schilders have allotted these names to a Malaysian race to Japan, and to a Melanesian one, though neither agree in any sense with the diagnoses of the colour varieties alone. It may be noted that West

Australia is associated with East Australia in the range of "*purissima*", but Western shells are large and stout and may represent a distinct race. A Queensland shell selected at chance is here figured, but so far no distinctive features have been determined. A series from North-west Is., Capricorn Group, Queensland, shows a very narrow, almost linear, aperture.

Erosaria poraria Linné.

(Plate xxvii., figs. 11-12.)

Mr. A. A. Cameron sent down a specimen of *poraria* for confirmation; it was exceedingly large, and upon reference all the New South Wales shells available are of the same large size. In the case of *poraria* the Schilders have divided the species into two, a Pacific and an Indian Ocean one, the latter being typical, and to the former they allotted a name, *scarabaeus* Bory. The latter is obviously unavailable, as it depends upon an unrecognisable picture, without locality. The Schilders regard the two forms as of equal size, form and appearance, the distinction being based on form, apertural characters and colour, 16:68:22:16 and 16:69:22:17. Consequently, as there are two or three separable subspecies in the Pacific, the New South Wales form is here named and described, the Cameron shell above-mentioned being taken as type. It is 25 mm. in length with 17 mm. in breadth (68%), and has 19 labial teeth and 15 columellar teeth, the base lilac, the teeth white, anteriorly the aperture widens, and each side is hollowed, altogether the aperture is comparatively wide. The edges are pitted, the right edge margined. The terminations are mauve, the back brown with numerous dull white spots, a dorsal line well marked. This may be called *Erosaria poraria theoreta* subsp. nov. New Caledonian shells appear to be smaller.

Erosaria wilhelmina Kenyon.

(Plate xxvii., figs. 13-14.)

The type of this species has been sent from the South Australian Museum for examination, and I find it to be a small pallid shell, which may be a pale aberration. It was well described by Mrs. Kenyon, who stated she had four others agreeing, so that this form should be kept distinct until more material is found exactly determining its status. The specimen is stout, well adult and is not albinistic in any sense, and the teeth are strong, differing appreciably from those of the eastern shells named *poraria*.

Erosaria helvola Linné.

This species has been separated into seven races by the Schilders, the typical race being given as ranging from "N. Malaysia to Cocos Is., etc.", though I had given as the restricted type locality, the Maldive Is. They use *callista* Shaw, 1909 = *agassizi* Ladd, 1934, for a race, "Polynesia to Henderson Is., Caroline Is., Torres Straits and Sydney", a somewhat confused range. Ladd gave the name *agassizi* to a Fijian subfossil, while *callista* was given by Shaw (Proc. Mal. Soc. (Lond.), Vol. viii., p. 311, August 10, 1909), to a large shell from Tahiti, measuring 29 mm. by 18 mm., with white extremities. The formula presented by the Schilders for their race named *callista* reads 19:70:18:15 as against *citrinicolor* 24:67:19:15, with the others from 19 mm. to the large South African *meridionalis* 26 mm. in length. A complication has arisen in that Mr. G. P. Whitley collected a shell at Dirk Hartog Is., Shark's Bay, W.A., which is very dark and has the fine teeth of *citrina*, but has lilac extremities, not orange. Other W.A. specimens, as already recorded, are of *citrina* coloration, but with the coarse teeth of *helvola*.

The Schilders have separated this species widely from *erosa,* but the Hawaiian *kauilani* Kenyon, cited as a synonym of this species, seems as near *erosa* as it resembles *helvola,* and I would allot it to the former in preference.

EROSARIA NASHI Iredale.

The Schilders have rejected *flaveola,* even as I did, but have utilised *labrolineata* Gaskoin, with range "E. Malaysia to S.W. Java, Palau and Japan", a race, *helenae* Roberts, ranging from "New Britain and Samaray to New Caledonia and Suvorov Is."; *nashi* being used for "E. Australia, Botany Bay to Fitzroy Is." However, the North Queensland shell is very distinct from the Sydney Harbour species, which ranges into South Queensland. Roberts described *Cypraea helenae* (Amer. Journ. Conch., Vol. iv., p. 250, pl. 15, figs. 7-10, February 4, 1869), from unknown locality, measuring $11\frac{1}{4}$ mm. by 5 mm. The North Queensland shell agrees superficially, but the description of the teeth does not exactly fit "teeth small, those on the outer lip strong, those on the inner lip not so strong, but more numerous", the figure showing twelve in each instance.

I would place *helenae* as an absolute synonym of *labrolineata,* save that the latter calls for brown lines on the base and bifurcated anterior columellar teeth. Therefore *helenae* would become the specific name of the white based form, and I designate Java as the type locality in order to clarify the position.

Mr. A. R. McCulloch collected a beautiful little shell alive on St. Crispin Reef, outer Great Barrier Reef, east of Cairns, North Queensland, and I am naming this *Erosaria maccullochi* in memory of this able and enthusiastic naturalist. The shell is small, measuring 12 mm. in length by 7 mm. in breadth, and is pale greyish green above marked with distinct white spots, the dorsal line broad and well defined. The dark terminal spots are ill marked posteriorly, pale but pronounced anteriorly, with a few lateral spots of brown; base shining white. The teeth are strong and stout, the anterior columellar teeth crassly flattened, the median ones thickened, the posterior ones produced, while the labial teeth are thick and pronounced; the teeth number thirteen in each case; the fossula recedes and only the anterior tooth crosses it, columellar sulcus obsolete. (Pl. xxvii., figs. 9-10.)

This is confirmed by a series collected at Michaelmas Cay, varying from 10.5 mm. to 19 mm. in length, the teeth varying in number, irrespective of size, columellar teeth varying from thirteen in a shell 16.5 mm. long to eighteen in a shell 17.5 mm. long, the labial teeth being fifteen in each case.

Apparently this is the coral reef representative of the southern *nashi,* which differs at sight in its browner coloration, larger size, more open mouth, and less crassate columellar teeth, bolder lateral spotting and stronger anterior blotches, but little posteriorly, the dorsal spots being comparatively smaller and more distant.

A curious matter is the location by the Schilders of this series and the *helvola* group under *Ravitrona* as a subgenus of *Erosaria,* as these look like miniature *erosa,* and the Hawaiian *kauilani* puzzled me as to whether it was *erosa* or *helvola.*

The animal of *nashi* was described by Mrs. Waterhouse as "very like heath, pink and sage green and tufted all over, and the foot not very long. It is more like *C. erosa* than any other".

EROSARIA TOMLINI Schilder, 1930.

(Plate xxvii., figs. 7-8.)

A Lemurian Cowry was named *cernica* by Sowerby, and a similar looking shell was found at New Caledonia, and the same name was used for it. Schilder separated it subspecifically with the name *tomlini,* but I am using that specifically. Specimens have been collected in New South Wales, South Queensland, Lord Howe Is., Norfolk Is. and the Kermadecs. There is little difference seen in the few shells available, but none seems to be very close to the Mauritian *cernica.*

Schilder named *Erosaria cernica tomlini* in the Proc. Mal. Soc. (Lond.), Vol. xix., p. 51, March 13, 1930, from Lifu, New Caledonia, as a slender dwarf race with a maximum length of 23 mm., the type being 12.4 only. Later the Schilders gave the formula of the subspecies as 17:64:21:18, writing "smaller than *cernica*", whose formula was given as 22:69:20:17, but the above-mentioned shells are all larger, one from Kurnell, Botany Bay, reaching 27.5 mm. in length by 18 mm. in breadth with eighteen columellar teeth and twenty labial teeth; one from Lord Howe Is. 28 mm., Norfolk Is. 30 mm., and Kermadec Group 31 mm. A specimen from the Ilot Amédée, Noumea, New Caledonia, measures 28 mm., thus confirming the alliance of the series, while one from Bampton Reef is only 15 mm., though a crassate adult shell. Upon re-examining this series it seems best to give a name to this larger shell, citing the figured Newcastle specimen as type, calling the subspecies *E. tomlini prodiga* nov.

EROSARIA PERCOMIS Iredale.

The Schilders questionably relegate this to the synonymy of *nashi,* commenting "The description and the figure of *percomis* are not sufficient to decide, whether it is a dilated *nashi,* or an Australian race of *cernica* allied to *tomlini*". It is neither for although it is dilated as typical *cernica,* it differs in lacking lateral spotting, and is quite unlike the local *tomlini.* The teeth on the inner lip are much more clearly cut, more regular, and not thickened anteriorly, columellar sulcus slight, with a couple of denticles only, no teeth crossing the sulcus nor appearing on the fossula. The mouth is notably narrower than that of *nashi* and the teeth are finer.

EROSARIA METAVONA Iredale.

(Plate xxvii., figs. 15-16.)

Although I had correctly rejected *miliaris* Gmelin, the Schilders persist in its usage, this time for a Japanese shell, and then utilise *differens* Schilder for a "Central Malaysia to Java, North Australia, etc.", race, and give *diversa* Kenyon as the name for the East Australian form ranging into North-east Australia. Mrs. Kenyon proposed her varietal name *diversa* for a shell supposed to have come from Shark's Bay, and it is not even certain that the name refers to this species. The only shell so far seen from Shark's Bay, Western Australia, is like *metavona,* but more pinched anteriorly and more elevated; it is dead, so that the exact coloration is unknown. It does not otherwise agree with Mrs. Kenyon's description.

Mr. Melbourne Ward collected *metavona* alive at Southport, South Queensland, and noted the animal recalled that of *erosa,* but unfortunately did not make a painting.

Specimens from the Northern Territory are similar to those from Torres Straits.

Erosaria eburnea Barnes.

When I compiled my List I had seen no Australian specimens, although the species, an unmistakeable one, had been recorded from Moreton Bay. Comparatively recently, Mr. A. A. Cameron picked up a handsome subadult shell at the mouth of the Clarence River, New South Wales, which he presented to this Museum. A little later he saw one in the collection of Mr. E. Hermann, which had been picked up on the beach at Ballina, a little further north still in New South Wales, which he persuaded Mr. Hermann to present to this Museum also. These appear to be broader than the New Caledonian shells, being 33 mm. by 22 mm., and 39 mm. by 25 mm. respectively. Fijian shells range from 37 to 41 mm. in length, and 23 to 25 mm. in breadth, while the New Caledonian shells grow much larger, measuring 45 mm. by 27 mm., 48 mm. by 28 mm., and 52 mm. by 30 mm., and thus represent a larger race, which may be called *E. e. mara* subsp. nov. Some Solomon Islands shells differ in shape, being more oval, recalling a refined *erosa* than the elegant pyriform *eburnea,* but they undoubtedly belong here. A few from the New Hebrides are smaller and stouter and may belong to another race.

Undoubtedly the species is quite distinct from *metavona,* although it belongs to the same small group. It is unfortunate that the Schilders should have used this group to illustrate specific and subspecific distribution (p. 225, fig. 9), as already their data must be revised.

The genus Monetaria.

(Plate xxvii., figs. 19-28.)

The Schilders have published an exhaustive account of the Money Cowries allowing four species, many subspecies, and a series of ecotypes. They even separate the *annulus* group as a subgenus classing *obvelata* thereunder, while their second species of *Monetaria* s.str., is *icterina* Lamarck. While their results are excellent they do not show the variation and distribution of these animals in life. Thus the type locality of *moneta* is the Maldive Isles, and the typical form is a small shell with nodules above and below posteriorly. Rochebrune separated sixteen species, but unfortunately used the shells as counters, and thus gave a confused distribution while recording many false localities. In Australia there appears to be four species, *"moneta", "mercatorium", "icterina",* and *annulus.* The Schilders admitted three races of *moneta,* two Indian Ocean and one Pacific one. This is not at all true of the Pacific Ocean shells, as there is more than one species living therein.

The small nodulose species varies with subspecies of its own, while the large *"mercatorium"* may also be divided, and the small *"icterina"* occurs alongside. The only name available is *barthelemyi,* based on a New Caledonian aberration, and the name should be restricted to the New Caledonian race. In the field there can be no doubt that these are not due to any ecological condition, as they are found associated together, and are easily distinguished. Mr. Ted Dranga gave me specimens he had collected at I. Tutuila, American Samoa, and these prove very interesting as the *annulus* form shows a raised torus and thus becomes near *obvelata.* It may be called *Monetaria annulus dranga* subsp. nov. (Pl. xxvii., figs. 27-28), as it is a very important form. The species *obvelata* was reported by the American Exploring Expedition from Samoa, but this was rejected, as all shells from Samoa have been regarded merely as *annulus.* The aperture recalls that of

obvelata and the teeth are variable, but resemble those of *obvelata*. A medium sized shell measures 20 mm. in length by 15 mm. in breadth, and 10 mm. in height; it has eight columellar teeth and eleven labial teeth, and the torus is well raised but not enveloping the *"annulus"* area, as in *obvelata*. A smaller shell shows more envelopment, and a larger one less. Specimens from Luma, and Ta'u with a note "most common at Ofu, an island ten or twelve miles west of Ta'u, in the Samoan group", sent by Mr. Wray Harris, show the *obvelata* tendency, but it is not so noticeable at first sight, while the teeth are similarly few in number but more produced, and confirm the distinction from typical *annulus*.

The distinction between the *"mercatorium"* series and the *"moneta"* group is well seen in the Samoan specimens given me by Mr. Ted Dranga, and those sent by Mr. Wray Harris. Mr. Ted Dranga's shells from Tutuila are small, with four prominent dorsal nodules, the base strongly nodulose, the aperture open, the yellowish green coloration showing a faint transverse band only. The length of the shell is 22 mm., the breadth 16 mm., and the height 11.5 mm., the teeth on the columellar side being ten, the anterior six short, the posterior elongated, three of them producing strong conical tubercles; the labial teeth are also ten in number, but only two or three anteriorly are short, most of the posterior ones again producing strong nodules. The dorsal nodules differ in appearance from those of typical *moneta,* so that this Samoan shell may be called *M. monetoides* sp. nov. (Pl. xxvii., figs. 25-26). On the other hand the shells from Luma and Ta'u from Mr. Wray Harris are larger, broader, with the dorsal nodulation missing, while the broad base is smooth. The shell measures 29 mm. in length and 23 mm. in breadth with a height of 16 mm. The dorsal surface is pale creamy white with a central paler area surrounded by a yellow *"annulus"* line. The four dorsal nodules of the *"moneta"* form are faintly indicated only, while basally the aperture is very narrow, the columellar teeth, twelve in number, short, none produced, the labial teeth thirteen, slightly produced, but none nodulose. This is a very distinct form through showing the *annulus* markings and is here named *Monetaria harrisi* sp. nov. (Pl. xxvii., figs. 19-20), to signify its many differences. A Rarotonga shell, collected by Mr. A. A. Cameron, belongs to this species.

Mr. G. P. Whitley collected a series at Rarotonga, some large and broad belonging to *harrisi*, others small and narrow, and apparently referable to a smaller species. The shell is much narrower, pale greenish above without markings, the juveniles showing the three narrow cross bands associated with the *moneta* form. The dorsal nodulation is obsolete and the aperture is not so narrowed as in the larger species, the teeth coarser and the labial ones produced a little but not nodulate. These appear to agree with the common Queensland form in general, and suggest the *icterina* style rather than *moneta* typical. Michaelmas Cay shells are here described as *M. isomeres* sp. nov. (Pl. xxvii., figs. 21-22). A medium shell measures 25 mm. in length and 19 mm. in breadth, the dorsal surface pale green with signs of the narrow banding; the dorsal nodulation is never pronounced, although always indicated. The aperture is narrow but anteriorly a little broadened; the teeth are short, the base smooth, columellar teeth number twelve, the labial thirteen. Shells from the Capricorn Group, South Queensland, are larger and deeper coloured, the teeth in some cases being produced and even slightly noduled, while shells from Murray Is., Torres Straits, are even deeper coloured and sometimes a little broader, but with the base smooth; these may be selected shells. Most of the shells collected in Queensland

appear referable to this species, and West Australian shells differ only slightly in that the anterior termination of the aperture offers a slightly greater declivity. They do not seem to be closely related to *moneta*, nor its eastern representative *monetoides*. Ellice Is. shells are similar to Samoan *monetoides*.

CRIBRARIA CRIBRARIA Linné.

(Plate xxvii., figs. 17-18.)

The Schilders allow four races, two Indian Ocean, one West Australian, and one other for the Pacific Ocean. For the lastnamed they use *melwardi*, which I proposed for a very distinct shell. Many specimens of *melwardi* are now before me, and its relationship with *cribraria* is admitted, but it is still a distinct species. In Queensland typically marked *"cribraria"* occur, while in New Caledonia the species grows to a large size, and shows a curious aberration, double spotting, advancing to multimarking almost obliterating the spots, and showing a dark brown netted appearance. Such cannot be correctly associated with the shining stout white *melwardi*, and therefore another name must be introduced.

As many large specimens occur in New Caledonia, a large one is selected for nomination as *Cribraria cribraria zadela* subsp. nov., a specimen from Hamilton Is., Whitsunday Group, Queensland, being selected as type. It measures 23 mm. by 13 mm., a norm of *melwardi*, being 21 mm. by 14 mm., it has the normal *cribraria* colouring, the dorsal line well marked, anteriorly more narrowed and posteriorly more produced. The mouth is more open, with the teeth coarser, thirteen columellar teeth and fourteen labial teeth, the columellar sulcus less defined, and the labial teeth more produced.

CRIBRARIA CUMINGII and GASKOINII.

According to the Schilders, *cumingii* is restricted to East Polynesia, while *gaskoinii* is an Hawaiian species. Consequently neither will occur in Queensland, and the species so recorded must be redetermined. The Schilders have introduced *catholicorum* for a Melanesian representative, but this has not yet been recognised.

STAPHYLAEA STAPHYLAEA Linné.

(Plate xxvii., figs. 23-24.)

The Schilders have separated *staphylaea* into four races, allowing *descripta* as the name for the East Australian race, admitting it may be larger than the Pacific race which they call *consobrina* Garrett. It will be found later that many races occur in these localities, especially as the Schilders range typical *staphylaea* from the Andamans to Japan and then include New Caledonia, but specimens from the lastnamed locality are very like some Queensland shells.

Genus BISTOLIDA.

1920. *Bistolida* Cossmann, Revue Critique Paléozool., 24th Year, p. 83, Oct. 23. New name for *Stolida* Jousseaume, 1884, not *Stolida* Lesson, 1831.

When I proposed *Derstolida* I overlooked this correction by Cossmann, as the Schilders had not recorded it either. It of course dispossesses *Derstolida*, and is also older than *Blasicrura*, which the Schilders had associated with it. Under the subgenus *Derstolida* the Schilders arranged

the *hirundo-kieneri* series, which does not seem accurate judging from animal characters.

BISTOLIDA FLUCTUANS Iredale.

(Plate xxviii., figs. 7, 8, 9, 10.)

This name was proposed to replace *stolida,* which does not occur in Australian waters as yet. I write "as yet" because the Schilders appear to assume that the *stolida* picturesque markings are absent as they had not been recorded. However, it is possible that *deceptor* may be a distinct species, and that the normally coloured *stolida* like shells a third. How the Schilders transfer names is seen in this case as *brevidentata* was described from "Borneo", and they have allotted it to Australia, using *stolida* for the Borneo species. The small *fluctuans* shells appear very distinct from the *deceptor* shells, but the peculiarly coloured *stolida*-like shells provide a puzzle. These occur as far south as Caloundra, beautifully coloured shells at Keppel Bay, while the *crossei* state from Palm Islands appears to have been similarly coloured.

The Schilders place under *brevidentata,* as well as *fluctuans* and *deceptor, moniontha,* a varietal name only, and certainly not from Australia, and *irvineanae* from South-west Australia. The lastnamed is not known exactly and cannot be here located yet. A figure of *deceptor* is given (Pl. xxviii., figs. 7-8), and of the *"crossei"* specimen from Palm Islands (Pl. xxviii., figs. 9-10).

TALOSTOLIDA TERES Gmelin.

(Plate xxviii., figs. 15-16.)

I recognised both *teres* and *subteres* from Australia, but the Schilders have restricted the latter to South-east Polynesia. There are two species here, as Mr. H. W. Hermann collected them together at Lady Elliot Island, South Queensland.

For the local form of *teres,* the Schilders use Links' *subfasciata,* a name given to a specimen in the Mus. Feldmann, from unknown locality. As the shell was illustrated in 1769, it is obvious that the shell must have come from Mauritius, as it shows a broad shell. Local shells are notably narrower, and the lateral spots fewer, the columellar and labial teeth both numbering twenty-one in a shell measuring 30 mm. long by 16 mm. broad. It may be called *T. teres pentella* subsp. nov., the type being a Lady Elliot Is. specimen (Pl. xxviii., figs. 15-16).

Mrs. Waterhouse has described the animal of a Port Jackson specimen as "the animal did not come out of the shell and was very little extended, but the foot was a rather pale orange colour with the mantle a little deeper".

The smaller Lady Elliot species is named *T. subteres hermanni* subsp. nov. (Pl. xxviii., figs. 13-14), as it measures 19 mm. long by 10 mm. broad and has also 21 columellar and labial teeth. It agrees in coloration with Sowerby's figure (*subteres*), but is broader, and according to the Schilders that shell has "extremely fine teeth".

PAULONARIA MACULA Angas.

(Plate xxviii., figs. 11-12.)

The Schilders have transferred *macula, fimbriata,* etc., from *Paulonaria* to the subgenus *Melicerona,* which they place under *Palmadusta,* for some

unknown reason rejecting *Evenaria*. Their location under *Melicerona* is not at all natural, and it would be better to separate the *minoridens* series as *Opponaria* gen. nov., and propose *Cupinota* gen. nov., with *macula* as type.

The shell listed, with doubt, as *fimbriata* appears to be *minoridens* Melvill, and the cylindrical small size, the more open mouth, especially anteriorly, the prominent columellar teeth and almost obsolete posterior teeth on the inner lip, the very short labial teeth all distinguish the group from the *macula* series. The columellar features easily separate both from *Melicerona*, the juveniles of which are characteristic.

The name *minoridens* was brought in as a substitute for *microdon* of authorities not of Gray, but Melvill did not name any type locality. The Schilders also failed to select a locality, but figured a shell from Lifu, whence also Melvill had specimens, so I designate Lifu as the type locality of *minoridens* Melvill (Journ. Conch., Vol. 10, p. 119, Oct. 1, 1901).

The genus *Opponaria* includes *fimbriata* Gmelin, *microdon* Gray, *serrulifera* Schilders, *waikikiensis* Schilder, and *minoridens* Melvill as listed by the Schilders under *Melicerona*.

The Schilders have divided *microdon* into three races, restricting the typical form to "S. Malaysia to Andaman Is. and Philippines", although it had been described from the Pacific Ocean. As it was also in the Mus. Stutchbury, I designate Fiji as the type locality, and name the Philippine Is. form figured by Reeve, *microdon katha* subsp. nov.

To come back to the *macula* series, the Schilders have arranged these under *gracilis,* allowing *macula* subspecific rank with range "E. Australia to Botany Bay and Shark's Bay", with a comment, "Later investigations will possibly prove the N.W. Australian shells to be distinct". Specimens, from Yirrkala, Northern Territory, are very like local ones, but the Shark's Bay shells are smaller and paler, and may be named *C. macula hilda* nov. (Pl. xxviii., figs. 11-12). The Schilders wrote, "Ecological varieties . . . in *macula* there is a smaller variety (*irescens*), which is more ovate with the terminal spots still more reduced than in large pyriform shells". This is rather a variable species on the East Coast and the small shells are not ecological varieties, while *irescens* is not a valid name.

I recorded a large pyriform specimen as *cholmondeleyi* as that was named from Australia, but the Schilders, apparently from examination of the type, now record the name as a synonym of *notata,* indicating that the locality given was incorrect. Until more specimens are received the local specimen is laid on one side.

The local specimens of *minoridens* are separated subspecifically as *O. m. blandita* nov. (type from Port Jackson) (Pl. xxviii., figs. 17-18) as they differ in their larger size, less projecting posterior extremities, less pronounced inner columellar ledge and also their greater proportional breadth.

Cupinota hammondae *sp. nov.*

(Plate xxviii., figs. 19-22.)

Mr. A. A. Cameron sent me down an immature shell which I could not determine, and then later secured another one from the same collector, Mrs. Hammond, a beautiful little adult shell, collected at the Clarence River, northern New South Wales.

In all generic details the adult agrees with *macula,* but is coloured in a different style.

It measures 18 mm. in length by 11 mm. in breadth and 8 mm. in height. The dorsal surface is creamy white densely, evenly freckled with pale yellowish brown, a median brown band indistinctly indicated. The extremities are tinged with pinkish lilac, an umbilical brown spot, the sides with a few dark brown dots, massed in the middle on the left side and scattered on the right side. The base is also creamy, the lateral dotting extending on the base on the left side. The aperture is of median width, the short labial teeth numbering sixteen, the columellar teeth fifteen, the anterior four or five stout and crossing the slight columellar sulcus, the remainder shorter and becoming obsolete posteriorly.

The juvenile is a cream shell with the outer lip just inturned and shows dorsally six narrow lines of squarish dots. An adult specimen was collected at Woolgoolga, N.S.W., years ago by Mr. C. F. Laseron and was unnamed, as it had suffered a slight fracture and this suggested that it might be an aberration.

A specimen from Yirrkala, Northern Territory, belongs to this species.

Evenaria asellus Linné.

(Plate xxviii., figs. 25-26.)

The type locality of this well known species is "Amboina" as the name is taken from Rumph, at the reference given by Linné. Unfortunately the Schilders have neglected this fact, and used *asellus* for the Mauritius race, *vespacea* Melvill, given to a colour variation, for the Amboina subspecies, *bitaeniata* Geret, based on a freak colour only, for the Queensland form, and *latefasciata* proposed for the southern New South Wales race. This lastnamed is very distinct, being large with very dark broad bands, and attracts attention at first sight. It is, however, difficult to separate North Queensland shells from Northern Territory shells, and the latter must be very close to the typical race. Geret's name was given to a colour abnormality only with two bands instead of three, and should be dismissed as such. A Northern Territory spcimen is figured showing the narrow dark bands as in Rumph's illustration. The northern shells differ in the prolongation of the posterior columellar teeth half way across the base, the southern *latefasciata* lacking this feature.

Evenaria hirundo Linné.

(Plate xxviii., figs. 29-31.)

The determination of this species has varied during the ages, but now it is accepted that Petiver's illustration refers to the species Sowerby distinguished as *neglecta*, and that Sowerby's *hirundo* be named *kieneri*. The Schilders have utilised this view, and admitted two other species, *owenii* and *ursellus*, defining subspecies in all the species. It is unfortunate that their names are not acceptable, but the truth is that the basis of the name *ursellus* is a *kieneri* form, and apparently will displace the later one, Schilders *ursellus* then taking the name of *coffea*.

The three species occurring in East Australia may be recognised by the features indicated by the Schilders, viz., *hirundo* is a plump medium sized (for the group) shell, the dorsal surface being bluish grey with a couple of small white markings towards each end and with the columellar teeth crossing the base; *ursellus* (= *kieneri* Schilders) is cylindrical, with the white markings more extensive leaving curiously shaped coloured markings, and the teeth of the inner lip only cross the base posteriorly, the anterior

teeth being short; *coffea* (= *ursellus* Schilders) is smaller, more pyriform, anteriorly a little narrowed and posteriorly the ends produced, the dorsal area showing coloured blotches not unlike those of the preceding species, but all the teeth of the inner lip are produced across the base.

The Schilders have introduced a new subspecies of *"kieneri"*, viz., *schneideri* for the form with a range "Melanesia to Geelvink Bay, Mapia Is., and E. Australia to Sydney". The type locality must be New Britain, as on p. 121, the Schilders stated they dedicated the race to P. Joseph Schneider, who collected Cowries in that locality. A topotype shows differences from New South Wales specimens so the latter are differentiated as *E. ursellus marcia* subsp. nov. (Pl. xxviii., figs. 23-24). In this form only three or four of the columellar teeth, the most posterior, are produced across the base, the type measuring 15 mm. in length by 9 mm. in breadth, being a shell collected, with many others, by Mr. A. A. Cameron at the Clarence River beaches, northern New South Wales.

All the eastern shells so far seen from many localities are small, so that *kieneri* may be retained for the large East African form almost an inch long, and the difference in the teeth may allow it specific value. It shows the same number of teeth in a shell almost twice the size, and there are other minor differences as indicated by the Schilders. From the description and locality it is obvious that Schilders' *depriesteri* is the typical *ursellus* of Gmelin, based on Rumph t. 39, fig. O, the markings agreeing, when it is remembered that the figure is reversed.

As a subspecies of *"ursellus"* = *coffea*, the Schilders introduced *amoeba* from "Melanesia from Eitapé and Port Moresby to New Caledonia" as being more pyriform and more inflated, with the lateral spots rather obsolete; its central labial teeth do not attain the lateral callus, which is crossed by the posterior teeth only.

A series from Michaelmas Cay belongs to this species, but the shells do not exactly agree. According to the Schilders' formula there should be 15-16 columellar teeth and 20 labial teeth in a 10 mm. specimen, but the Queensland shells have 12-13 columellar and 15 labial teeth in a 12 mm. shell. The type locality of *amoeba* is here designated as Eitapé, and the Michaelmas Cay subspecies named *E. coffea endela* subsp. nov. (Pl. xxviii., figs. 36-37).

For the Melanesian expression of *hirundo* the Schilders have used *rouxi* Ancey for which there is no illustration cited. For the North Australian shell with an apparent range from Shark's Bay, Western Australia, Northern Territory, Queensland, and northern New South Wales, I propose *E. hirundo cameroni* subsp. nov. (Pl. xxviii., figs. 29-31), but it may be a distinct species. Many dead shells are available from Yirrkala, Northern Territory, and living ones from Lindeman Is. and dead ones from the Clarence River, New South Wales, collected by Mr. A. A. Cameron. The general features have been given above and the colour markings are here shown, the type, the living shell measuring 19 mm. in length by 11 mm. in breadth, columellar teeth sixteen, labial teeth eighteen in number from Lindeman Is., Queensland.

Mr. A. A. Cameron has also given me a specimen collected at North-west Island, measuring 21.5 mm. in length by 15 mm. in breadth. It is dead, but shows more lateral spotting than the preceding, and apparently represents a different form, which may be called *E. peropima* sp. nov. (Pl. xxviii., figs. 38-39).

Dautzenberg has named Weinkauff's figure of a similar broad shell from Borneo, var. *abbreviata* (Journ. de Conch., Vol. 50, p. 311, 1902).

Evenaria punctata Linné.

(Plate xxviii., figs. 32-35.)

I allowed two species in Queensland, *punctata* and *atomaria*, but the Schilders have lumped these into one, with four races, restricting *punctata* to the Eastern Indian Ocean, using *atomaria* for a Western Indian Ocean race, introducing *iredalei* for a South Melanesian race, citing the Lindeman Island figure, and adding *trizonata* Sowerby for an East Polynesian race. The lastnamed is certainly a distinct species, even from the Schilders' own remarks. While *iredalei* may be used for the shell I recorded as *atomaria*, the Michaelmas Cay shell I regarded as *punctata* is undoubtedly different, having many small spots dorsally, the posterior end not incrassate umbilicad, the teeth coarser and colourless, though more produced on the base. This may now be named *Evenaria persticta* sp. nov. (Pl. xxviii., figs. 34-35).

Although *punctata* appeared on the New South Wales List, this proves to have been due to an erroneous location of "Bird Is." Hedley associated this locality with an island near Port Stephens, whereas the Bird Island in the Coral Sea was intended by Brazier as corrected in the Australian Museum, where the specimen is preserved. However, we can still retain it, as *iredalei*, as Mr. J. C. Wiburd collected a lovely specimen alive at Brunswick Heads, Northern New South Wales (Pl. xxviii., figs. 32-33), and Mr. A. A. Cameron sent a dead one collected by Mrs. Alf. Fisher at the Clarence River, N.S.W.

Evenaria carula *sp. nov.*

(Plate xxviii., figs. 27-28.)

Amongst a large number of small Cowries collected at Yirrkala, Eastern Arnhem Land, Gulf of Carpentaria, by the Rev. and Mrs. Wilbur Chaseling was a small shell recalling the *punctata-atomaria* series. Shell small, elegantly pyriform, measuring 10 mm. in length and 6.5 mm. in breadth. Coloration white, sparsely spotted with brown, a brown spot on the umbilicus and one on each side of the anterior extremity. In the *punctata-atomaria* shells such spots are small and insignificant, but in this shell they are notable while lateral spots are small. The base is white, the mouth narrow, the columellar teeth sixteen, half crossing the anterior columellar sulcus, but none extending on to the base and there are no yellow lines; the labial teeth number fifteen, short, yellow streaked. The anterior terminal ridge projects strongly. A dead specimen occurs among the Michaelmas Cay, Queensland, material. Comparison with specimens show *iredalei* to be a larger shell, more cylindrical with the posterior extremities calloused, umbilical dot and anterior dots almost negligible, while the yellow streaks on the base, both sides of the aperture are striking.

The mouth of *persticta* is more open, the columellar sulcus recessive, no yellow lines basally and the posterior columellar teeth are produced, the labial teeth numbering sixteen, the columellar fifteen, the shell measuring 16 mm. in length by 9.5 mm. in breadth.

Palmadusta clandestina Linné.

(Plate xxix., figs. 5-8.)

The type locality is Ceylon, and the Schilders have admitted four

subspecies, only one in the Pacific Ocean from Botany Bay to Rarotonga. For this complex they have utilised *candida* Pease, given to a Central Pacific aberration.

However, there appear to be recognisable subspecies in this area, as the series from the Great Barrier Reef are all smaller, and stouter than the mainland ones, while the name *candida* is applicable to neither.

A series from Michaelmas Cay, North Queensland, is composed of small solid pyriform shells, anterior end somewhat cramped, 14 mm. long, 9 mm. broad and 7.5 mm. high. The dorsal surface is shining white with three pale fulvous zones of equal width with narrow white intervals; the sides white, unspotted, thickly glazed. In the clean dead shells available the characteristic lining appears missing, and if it has ever been present it must have been very faint. The photograph shows it up. The mouth is narrow, fairly even, the ends a little produced, the columellar teeth, fourteen, extend half way across base and also internally, the columellar sulcus slight, a little recessive, the anterior teeth continuous across it, the posterior teeth not reaching across the fossula, while the labial teeth, sixteen, are produced about half way across the left side, although I was at first inclined to associate these with *artuffeli*, I am naming them *P. clandestina whitleyi* subsp. nov. (Pl. xxix., fig. 6).

Southern shells are larger, less solid, less pyriform, anteriorly broader, clouded but zoning indistinct, and zigzag lines notable and persistent even in dead shells; the teeth are less pronounced, coarser and, though the shells measure 19 and 20 mm. long, the number of teeth is the same, columellar teeth fourteen, labial teeth sixteen, as in the smaller shells. These may be named *P. clandestina extrema* subsp. nov. (Pl. xxix., figs. 7-8), the type coming from Shellharbour, New South Wales. As a feature of the African form of *clandestina* the Schilders have noted that the extremities are dorsally orange. No such coloration has yet been seen in Eastern Australia, but a specimen from Yirrkala, Northern Territory, is thus coloured and is also narrower than usual (Pl. xxix., fig. 5). More material is awaited to determine the significance of this difference.

After I had differentiated *Evenaria* for the *asellus* group, I added *Palmadusta* for the *clandestina* series, and the animal characters appear to justify this separation, though the shells are alike generally. The Schilders have suppressed *Evenaria* and used *Palmadusta*, which is technically incorrect. At present I am still allowing both genera, and if combination became necessary *Evenaria* must be used. Instead of combination I suggest there will be more subdivision as in the case of the *hirundo* series, and probably also the *humphreyii* group.

A figure of *P. saulae nugata* is here given (Pl. xxix., figs. 9-10), a still larger specimen having recently been collected at Hayman Is., Whitsunday Group, Queensland, by Mr. H. W. Hermann.

Palmadusta humphreyii Gray.

(Plate xxix., fig. 11.)

Mr. A. A. Cameron wrote: "On Saturday, September 2, 1939, I found a live specimen at Iluka, Clarence River, N.S.W. The mantle was not quite scarlet, spotted with small brown dots, the same colour as that of the shell. The mantle is also covered with small brown filaments, some of which are thicker than others, the very fine ones being white; although the white filaments are distributed throughout the mantle the white is not very

noticeable due to the fineness of the filaments. The tentacles are the same colour as the mantle, the siphon very short. Another impression was that of a very bright *macula* with small brown dots on the mantle".

At Long Reef, north of Manly, N.S.W., Mr. Mel. Ward found a very young specimen, the mantle, covering the shell, being deep orange red thickly spotted with brown. The top of the foot was a little paler and thinly speckled with brown dots. The sole of the foot was also orange red, as were also the siphon and tentacles.

Many years ago Mrs. Waterhouse wrote "has a bright light red foot, the mantle a darker bright red with tiny white tufts and tiny speckles of black".

Mr. Cameron also sent a very beautiful juvenile shell which proved that this was very distinct from the North Western *bizonata* (Pl. xxix., fig. 12) as it was faintly banded with white but very densely speckled with brown (Pl. xxix., fig. 11).

PALMADUSTA ZICZAC Linné.

(Plate xxix., fig. 13.)

As no locality was given for this species, and as the Schilders have used the name for a race from S. E. Malaysia to Japan, I have designated Amboina. The Schilders have separated four races, and have utilised *vittata* Deshayes, for a form ranging from Melanesia to New South Wales. The name *vittata* is based on an illustration without locality, and our shells do not even agree with the figure. As locality of *vittata,* I designate Amboina, and thus relegate it to the synonymy from which it should not have been resurrected. The Schilders state that the Melanesian race differs from the Malaysian in coloration and slightly in form; specimens available are not sufficient to confirm the diagnostic features given, but a Clarence River shell is figured and named *P. ziczac signata* subsp. nov.

GRATIADUSTA PYRIFORMIS Gray.

This species was described without locality, and I accepted Sowerby's record of Ceylon, but the Schilders have questioned that locality, giving a range of "S.E. Malaysia and N.W. Australia to Queensland and Mergui Arch." without any subspecies, and synonymising *smithi* Sowerby and *kaiseri* Kenyon. The lastnamed, of which the type is before me is a very distinct species, while *smithi* appears also valid, and there is another easily separable form. Too many specimens are not available, but I have a suspicion that the curious *Ipserronea problematica* may be the juvenile of one of the species. The Schilders referred this to *Erronea* with which it obviously has no relationship, the juveniles of *Erronea* being very common and well known.

A shell from N.W. Australia, regarded as *smithi* is shaped like *macula* with similar lateral spotting, a black umbilical spot and a dorsal blotch. The underside shows a mouth, something after the style of *pyriformis,* the four columellar anterior teeth white, ten posterior fine and brown.

GRATIADUSTA KAISERI Kenyon.

(Plate xxix., figs. 16-17.)

The type of this species is preserved in the South Australian Museum,

and is now before me on loan. It was well described by Mrs. Kenyon, and should never have been synonymised. It differs at sight in lacking the banding always associated with *pyriformis,* only the reddish anterior columellar teeth recalling that species, but the fossula recedes more anteriorly, and the teeth are shorter, the columellar sulcus being slight. The aperture a little narrowed anteriorly.

Dead shells collected in Queensland at Seaforth, north of Mackay, and at Townsville, are larger and plumper, but have the same elegant shape, and very similar apertural characters, and apparently represent this species on the East Coast. They occur alongside large *pyriformis,* and seem very distinct, not micromorphs of that species.

GRATIADUSTA CONTINENS Iredale.

(Plate xxix., figs. 14-15.)

I described this as a subspecies of *walkeri,* and consequently the Schilders have used it as the East Australian representative, allotting *walkeri* typical to N. Lemuria, and naming *bregeriana* as a third subspecies. Recent collections have proved the validity of *continens,* and the occurrence of a form of *walkeri* living alongside, which has a black animal. Therefore we have two species in Queensland *"walkeri"*, and *continens* with another species *bregeriana* in New Caledonia. The lastnamed is nearer *continens* in dorsal coloration than *walkeri* s.l., but can never be confused, the base coloration and white specking being diagnostic. An adult specimen of *continens* collected at Peel Island, Moreton Bay, Queensland, has only a few lateral spots, dorsally a little clouded, but otherwise in close agreement with the type of *continens* measuring 33 mm. by 20 mm. The mouth is still open, the columella receding and only two anterior teeth crossing, no sulcus being present. The four anterior columellar teeth are strong and distant, the remainder being closely set, fine and long, but produced neither internally nor externally, the fine teeth number twenty, while the short stout labial teeth are about the same number.

The Schilders regard the Philippine Island shell as a subspecies of *walkeri,* and the local *walkeri* differs from that in coloration, and in teeth formation, but belongs to that specific form.

The *"walkeri"* shells collected in Queensland differ from *continens* in being small, more narrowed, and less pyriform. The dorsal surface lacks the dense spotting, speckling only occurring on the side near the margin where there are half a dozen brown spots. The general coloration above tends to shades of lilac with narrow whitish banding, one above the middle with a series of squarish brown blotches, the other below with a similar series on each side, the upper one only show a series above. The base is a rich fulvous, the teeth with purple interstices; the columellar teeth have three anterior larger and separated, and seventeen closer, long, and the most posterior produced; the labial teeth short, sixteen in number. The columella recedes as in the preceding species.

For the present this is named as a subspecies of *G. walkeri, merista* subsp. nov., the type measuring 23 mm. by 13 mm., collected at Hayman Is., Whitsunday Group, Queensland (Pl. xxix., fig. 20-21).

GRATIADUSTA XANTHODON Sowerby.

This beautiful shell has a very restricted range in East Australia only

on the mainland as yet; in some localities being almost common. The animal is a very beautiful one and has been described by Mr. H. Bernhard from specimens collected at Emu Park, Keppel Bay, Queensland, as follows: "Siphon and mantle brownish green, base of mantle pinkish, the branched filaments being bright red. Foot greenish white with brown dots. Edge of mantle black with white dots along it. Tentacles and siphon red, the latter fringed with white. Viewed from above the animal has a greenish hue".

Solvadusta vaticina Iredale.

(Plate xxix., figs. 18-19.)

I used this name for the Lindeman Is. animal, and allotted *subviridis* to the North and West Australian species. The Schilders have restricted *vaticina* to northern New South Wales, *subviridis* to North Queensland, and introduced *dorsalis* for the West Australian form (Pl. xxix., figs. 18-19).

Mr. G. P. Whitley recently collected a specimen at Broome, North-west Australia, crawling on the surface of a rock between tide marks on a hot day. Upon handling it the animal crawled actively over his hand, and he describes it as follows: "Mantle mottled rusty brown or cream with dark grey linear markings and warty processes. (These warty processes may be collapsed filaments.) Foot extended beyond shell, dull white, densely mottled with dark grey on top of extended portion. Anterior edge of foot showing linear markings, muzzle bright orange red, siphon brown, with paler fimbriate edge, tentacles orange yellow, darker towards base. Sole of foot dull white".

This is quite unlike the animal of *vaticina* (Austr. Zool., Vol. viii., pl. viii., fig. 9), but approaches fig. 8, which was tentatively allotted to *Erronea chrysostoma*. Apparently that figure must now be transferred to *subviridis*, and *vaticina* widely separated, although the shells are very easily confused. Juvenile shells of *vaticina* also recall those of the very different *pyriformis*.

Melicerona melvilli Hidalgo.

(Plate xxix., figs. 22-26.)

When using Hidalgo's name I noted that our form was more elongate than Hidalgo's cited figure from "Amboina", and also recorded the occurrence at the Capricorns of pathological varieties of the New Caledonian style.

New Caledonia is famed for the curious aberrations of Cowries there found showing a strong tendency to rostration and melanism. These are due to some disease which attacks all the species and is almost restricted to the locality. Thus Dautzenberg has recorded (Journ. de Conch, Vol. 54, pp. 263-266, pl. ix., 1906) as being affected, *neglecta, caurica, stolida, mappa, eglantina, moneta, annulus, vitellus, lynx, errones, asellus, clandestina, punctata, cribraria, erosa, staphylaea, poraria, scurra, carneola, mauritiana, arabica* and commented "*tabescens elaiodes* Melvill is due to disease".

I have given this list as I find *melvilli* is not included, yet this is strongly attacked at the Capricorns, many specimens having been collected by Mr. A. A. Cameron showing melanism, humpbacked, and elongated aberrations. The same enthusiast has sent a large series from the Clarence River, New South Wales, which is composed of larger broader shells with a tendency to dark coloration, but not the melanistic diseased appearance, and no

rostrations occur. Southern shells are normal, and the animal of a specimen collected at Long Reef, near Manly, N.S.W., by C. F. & J. Laseron is described. "Mantle thin translucent brownish flesh, without filaments, towards the foot same colour as that, pinkish minutely spotted with brown, edge white with a darker line inside; anteriorly the foot has a wavy edge. The siphon is pale brown, fringed, the tentacles brownish red".

Reverting to the disease-striken Cowries of the Capricorn Group, Mr. Cameron collected specimens of *erosa, vanelli,* etc., attacked in places, and *nimiserrans* and *caurica* showing darkened dorsal areas. But the most curious case is that of a fine *tigris* showing a broad white longitudinal band suggesting that the mantle supplying colour had failed to reach this area. Later Mr. Cameron collected shells of *vitellus* and *arabica,* alive, showing a similar broad longitudinal area, but in these instances the surface was eroded away, a feature not before seen in living Cowries.

For the form ranging through Amboina from the Andaman Is. to Japan, the Schilders have introduced *pauciguttata,* citing Hirase's Japanese figures as illustrative, so I designate Japan as the type locality. This will leave *melvilli* free for the Amboina form with restricted geographical limits, and I propose *M. melvilli velesia* subsp. nov. for the southern race, a Clarence River shell being selected as type measuring 21.5 mm. by 12.5 mm. (Pl. xxix., figs. 22-23). These average about 20 mm., the largest being 26 mm. by 15 mm., the columellar teeth being about 12 and the labial about 14 in number. The Capricorn Group shells are generally narrower through disease as here figured (Pl. xxix., figs. 24, 25, 26).

Blasicrura quadrimaculata Gray.

As this species was introduced from unknown locality and the Schilders have admitted three subspecies, restricting the typical one to "Central Malaysia, Luzon, etc.", I designate "Amboina" as the type locality.

The Schilders then proposed *garretti* for the race, ranging from Fiji to the Solomon Is. and Astrolabe Bay, and for this race I select Fiji as the type locality. The third subspecies was named *thielei,* the distribution being "Broome to Queensland (Lindeman Is.)" with the illustration of the Lindeman Is. shell given in the Austr. Zool., Vol. viii., pl. ix., fig. 6, being cited as exemplifying the race. I therefore designate this specimen as the type of *B. q. thielei.*

Palangerosa cylindrica Born.

(Plate xxix., figs. 29-30.)

The Schilders have allowed two races, *sowerbyana* from North-west Australia, and *cylindrica* typical from "S.E. Malaysia to Jap, Japan, New Caledonia and Gilbert Is., Tahiti?" They suggest that the Pacific form may be distinct. Our West Australian shells do not agree with Sowerby's figures, 269-270, which moreover are localized as "Indian Ocean, Ceylon, Philippines" and the teeth "labii brevioribus (*cylindrica*) columellae brevissimis". I designate Ceylon as the type locality of *sowerbyana.* It may be pointed out that when Schilder introduced *sowerbyana,* citing only Sowerby's figures he gave as localities "S.E. Asien (Loy.-Bro.-Chi.)". As noted previously, West Australian shells are only very slightly different from typical *"cylindrica",* while East Australian ones appear to be very regularly cylindrical. The Schilders observe "they seem to be smaller, thinner, with the

aperture wider, the labial teeth more distant, and the columellar ones more numerous".

This may be named *P. cylindrica lenella* subsp. nov. (Pl. xxix., figs. 29-30), the shells from Michaelmas Cay being small, as stated, the labial teeth numbering fifteen, stout and produced, the columellar nineteen, also produced, but thin, the shell measuring 23 mm. by 11 mm.; larger dead shells from the Capricorns reach 34 mm. in length. The Western shell measures 36 mm. by 19 mm., is ovate, the teeth less pronounced, and the same number, and this may be named *P. cylindrica sista* subsp. nov. (Pl. xxix., figs. 35-36). However, as cylindrical shells occur also in the North and North-west, this may be specifically distinct.

Erronea nimiserrans Iredale.

(Plate xxix., figs. 27-28.)

Unfortunately the Schilders have continued the misusage of *errones* for this species, and then classing all the Australian forms as one subspecies have used *coxi* Brazier, given to a West Australian shell, which may or may not be an aberration of this group. I suggested in my previous account that there was much variation, and this is not yet correctly interpreted. However, there are two series occurring in Queensland, a larger and a smaller, and these appear to represent different species.

Mr. Melbourne Ward figured the animal of a Lindeman Island shell and this was named as above. However, the larger shells have a different animal and apparently also different juveniles. Mr. Mort tells me that the "*errones*" seen at Caloundra, Queensland, was branched as described by Quoy and Gaimard for *olivacea*. This was confirmed by Mr. H. Bernhard, who examined living animals at Emu Park, Keppel Bay, Queensland. "A large dark coloured shell, 38 mm. in length by 20 mm., showed a white body with black dots massed in some numbers giving a blackish appearance. Scattered over the mantle are many fine branched filaments of a very light yellow colour. Tentacles and mouth red. Siphon same colour as mantle with fine black hairs on edge. The foot white dotted with black more lightly than the mantle giving a grey mottled effect. Paler shells appear to have less black on mantle showing a lighter coloured animal".

More recently the Laserons collected a specimen at Long Reef, near Manly, N.S.W., and this was described thus: "Foot marbled grey and black with white specks. The mantle blackish grey with white specks and numerous fine bunches of bright yellow filaments". It will be noted that all these differ from Mr. Mel. Ward's specimen, and the accuracy of that description is confirmed by an account by A. Adams in the Voyage of the Samarang, which I previously overlooked. As to the shells a further study of available specimens has shown that a series collected at Michaelmas Cay, North Queensland, was composed of very small shells, about 18 mm. in length, a similar series had been secured at the Hope Islands, another series from Low Isles, about 22 mm. in length, while Capricorn Island shells were a little larger but still small, about 25 mm.

Beautiful large shells have been secured at Lord Howe Island, but Mr. A. A. Cameron has sent down a series showing variation, including large and small shells, showing a tendency to broadening. West Australian shells are generally broader, some comparatively very broad shells being found with a breadth of 65%. Probably some of these have been mistaken for *ovum* and *chrysostoma*, but there is no reddish coloration on the teeth,

while this is never missing on the Eastern specimens of *chrysostoma*. Along with these broad shells here occurs cylindrical shells to which *coxi* may apply, but this has not been proved.

It will be useful to designate these large shells as *E. magerrones* sp. nov., the Keppel Bay shell being the type (Pl. xxix., figs. 31-32), and regard the West Australian shell as a broader subspecies, *E. magerrones proba*, subsp. nov. (Pl. xxix., figs. 33-34).

Erronea caurica Linné.

(Plate xxix., figs. 1-4.)

The Schilders have separated no fewer than seven races of this species, allowing *longior* from North Australia, while they use *obscura* Rossiter for the Pacific form. However, *obscura* Rossiter given to a colour aberration from New Caledonia is invalid as there is a prior *obscura* Gaskoin. The Pacific *"obscura"* Schilders is very similar to *longior*, but the coarser and more produced teeth seem to separate it, while it does not grow quite so long. It may be renamed *E. caurica thema* subsp. nov. (Pl. xxix., fig. 12), the type being the New Caledonian *"obscura"* shell figured. The West Australian shells are notably broader, though otherwise showing the general features of Australian *caurica*, viz., length, lack of marginal thickening, short coarse teeth, and may be called *E. caurica blaesa* subsp. nov. (Pl. xxix., figs. 3-4).

Ovatipsa chinensis Gmelin.

The Schilders have recognised the distinction of *Ovatipsa*, but have placed it as a subgenus of *Cribraria*, a location that appears very unsuitable. The nearest form seems to be *Erronea caurica*, especially as *coloba* is admitted as a second species of *Ovatipsa*, and there is on record a long discussion as to whether *coloba* was a variety of *caurica* or *chinensis*. The typical *chinensis* is allowed by the Schilders to range from Japan to N.W. Australia, and New Caledonia, assigning *variolaria* Lam. to Mauritius, etc., though I had designated Amboina as the type locality, and then they have introduced a new subspecies, *sydneyensis*, for the shell I recorded as *chinensis*, suggesting that it may have spread from another geographical centre. Obviously the only centre would be New Caledonia, and through the enthusiasm of Mr. A. A. Cameron I have received a fine specimen collected by Mrs. Alf. Fisher at the Clarence River. It agrees fairly closely with New Caledonian specimens, though it shows the fewer coarse teeth of the Sydney shell. A shell with a label "Torres Straits" agrees in teeth characters, but the back shows no lacunae, thus recalling the Mauritius *variolaria*.

EXPLANATION OF PLATE XXVII.

Figs. 1, 2. *Zoila friendii vercoi* Schilder. Type.
,, 3, 4. *Zoila episema* Iredale.
,, 5, 6. *Erosaria erosa* Linné.
,, 7, 8. *Erosaria tomlini prodiga* Iredale.
,, 9, 10. *Erosaria maccullochi* Iredale.
,, 11, 12. *Erosaria poraria theoreta* Iredale.
,, 13, 14. *Erosaria wilhelmina* Kenyon. Type.
,, 15, 16. *Erosaria metavona* Iredale.
,, 17, 18. *Cribraria cribraria zadela* Iredale.

„ 19, 20. *Monetaria harrisi* Iredale.
„ 21, 22. *Monetaria isomeres* Iredale.
„ 23, 24. *Staphylaea staphylaea descripta* Iredale.
„ 25, 26. *Monetaria monetoides* Iredale.
„ 27, 28. *Monetaria annulus dranga* Iredale.

EXPLANATION OF PLATE XXVIII.

Figs. 1, 2. *Arabica perconfusa* Iredale.
„ 3, 4. *Arabica westralis* Iredale.
„ 5, 6. *Arabica scurra antelia* Iredale.
„ 7, 8. *Bistolida fluctuans deceptor* Iredale.
„ 9, 10. *Bistolida crossei* aberration.
„ 11, 12. *Cupinota macula hilda* Iredale (enlarged).
„ 13, 14. *Talostolida subteres hermanni* Iredale (enlarged).
„ 15, 16. *Talostolida teres pentella* Iredale.
„ 17, 18. *Opponaria minoridens blandita* Iredale.
„ 19, 20. *Cupinota hammondae* Iredale.
„ 21, 22. *Cupinota hammondae* juvenile (enlarged).
„ 23, 24. *Evenaria ursellus marcia* Iredale.
„ 25. *Evenaria asellus* Linné.
„ 26. *Evenaria asellus latefasciata* Schilder.
„ 27, 28. *Evenaria carula* Iredale.
„ 29, 30. *Evenaria hirundo cameroni* Iredale (living shell).
„ 31. *Evenaria hirundo cameroni* (dead shell).
„ 32, 33. *Evenaria iredalei* Sch.-Schilder.
„ 34, 35. *Evenaria persticta* Iredale.
„ 36, 37. *Evenaria coffea endela* Iredale.
„ 38, 39. *Evenaria peropima* Iredale.

EXPLANATION OF PLATE XXIX.

Figs. 1, 2. *Erronea caurica thema* Iredale.
„ 3, 4. *Erronea caurica blaesa* Iredale.
„ 5. *Palmadusta clandestina* Linné.
„ 6. *Palmadusta clandestina whitleyi* Iredale.
„ 7, 8. *Palmadusta clandestina extrema* Iredale.
„ 9, 10. *Palmadusta saulae nugata* Iredale.
„ 11. *Palmadusta humphreyii* Gray. Juvenile.
„ 12. *Palmadusta bizonata* Iredale.
„ 13. *Palmadusta ziczac signata* Iredale.
„ 14, 15. *Gratiadusta continens* Iredale.
„ 16, 17. *Gratiadusta kaiseri* Kenyon. Type.
„ 18, 19. *Solvadusta subviridis dorsalis* Sch.-Schilder.
„ 20, 21. *Gratiadusta walkeri merista* Iredale.
„ 22, 23. *Melicerona melvilli velesia* Iredale.
„ 24, 25, 26. *Melicerona melvilli.* Diseased specimens.
„ 27, 28. *Erronea nimiserrans* Iredale.
„ 29, 30. *Palangerosa cylindrica lenella* Iredale.
„ 31, 32. *Erronea magerrones* Iredale.
„ 33, 34. *Erronea magerrones proba* Iredale.
„ 35, 36. *Palangerosa cylindrica sista* Iredale.

A REVISION OF THE AUSTRALIAN SAWFLIES OF THE GENUS *PERGA* LEACH, *sens. lat.* (HYMENOPTERA SYMPHYTA).

By Robert B. Benson, M.A., F.R.E.S., F.L.S.,
Department of Entomology, British Museum (Natural History).

(*Communicated by G. A. Waterhouse, D.Sc.*)

(44 text-figures.)

The insects dealt with here comprise the whole of the subfamily *Perginae* (*Pergidae*) in my scheme of classification, Benson (1938).

This study was initiated when naming some sawflies received from Mr. J. C. Clark of the National Museum, Victoria. Great difficulty was experienced in using Morice's key (1919) as some of the main group characters seemed uncertain in their application to individual specimens or species, and arbitrary in that in the resulting classification what appeared to be closely related species sometimes got widely separated. Also that while some of the groups seemed to be based on trivial and variable characters, a whole host of unused structural characters were noticed in the specimens examined.

My excuse then for writing this paper is that I believe that I have overcome some of these difficulties by abandoning the main grouping used by Morice and reclassifying the whole according to a different set of characters, many of them not used before and often cutting right across Morice's arrangement. Morice expressly says (p.250) that in *Perga* and *Pterygophorus* he took some trouble "to make the order in which the species are arranged to correspond to my idea of their natural affinities. . . . "

Many of the sixteen or so groups of species into which I have now broken up the main mass will in due course probably have to be regarded as distinct genera. Owing to the great number of new species that are certain still to be found, especially if careful collecting and biological studies are made, I have hesitated to split up the genera too finely. This is far better left until some such time as when it seems no longer possible to get new species, so that the likelihood of intermediates occurring between the "Groups" is more remote. In the meantime, I have made a compromise: the old genus *Perga* now represents a subfamily (the *Perginae*) divided into two tribes and eight genera, several of which consist of more than one of the basic species-groups.

The new genera proposed by Shipp (1894) are, as Morice says, based on trivial and useless characters, some even non-existent, in spite of his confident foreword! At the same time, and for entirely other reasons than the ones given by Shipp, some of his genotypes do happen to fall into distinct genera, so that their names become available for the genera.

In addition to the types of Leach, Kirby, Westwood, Rohwer and Morice in the British Museum, I have, through the kindness of Prof. G. D. Hale Carpenter, been able to examine the types of Westwood in the Hope Department, Oxford, and through the kindness of Dr. W. Horn, the types of

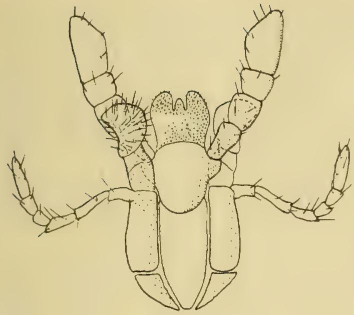


Fig. 1.

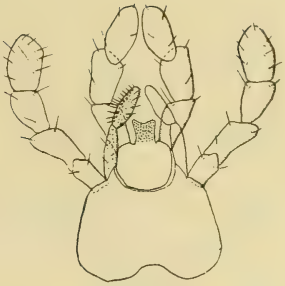


Fig. 2.

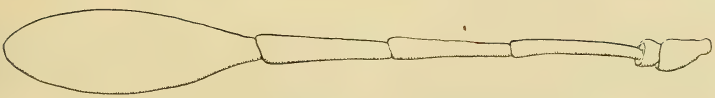


Fig. 3.

Fig. 4.

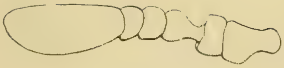


Fig. 5.

Fig. 6.

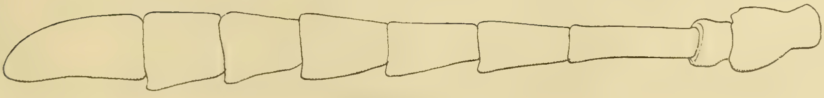


Fig. 7.

Konow in the Deutsches Entomologisches Institute, Berlin; I have also to thank the following who have enabled me to examine much additional material: Mr. Herbert H. Hale, Director of the South Australian Museum (including many of Forsius' types); Dr. C. Anderson, Director of the Australian Museum, Sydney; Dr. A. L. Tonnoir, of the Council for Scientific and Industrial Research, Canberra, F.C.T. (especially for lending me the material bred from the larvae described by W. W. Froggatt); Mr. H. A. Longman, Director of the Queensland Museum; Mr. L. Glauert, Curator of the Perth Museum; Mr. E. R. Wilson, of East Malvern, Victoria, and Mr. P. Buck, Director of the Bernice P. Bishop Museum, Honolulu, Hawaia.

Detailed larval studies are much needed in this group and would no doubt reveal many more species. Actually the larvae of very few species have been described at all, despite the very great interest that surrounds their colonial habits. In this connection it is a pity that even in recent studies of the larvae the species of *Eucalyptus* concerned has often not been reliably identified, as all evidence of this nature is of the utmost importance to the systematist. So also are the long series of individuals, often obtained by breeding, invaluable to the systematist as enabling him to see the range of variation within the species.

The species *P. tristis* Forsius, 1935, pp. 14-15 (from Victoria and said to be near to *P. antiopa* Morice or *P. essenbecki* Westwood), has been omitted from the keys as I have been unable to see any material of it, and, from the description, I am not able to tell where it should be placed.

In the key that follows most of the synonymy is based on actual type comparison; in the few cases where this has not been possible the synonymy is queried.

Key to Genera of Perginae.

1. Maxillary palp slender and 6-segmented; labial palp 4-segmented and about twice as broad as the maxillary palp (fig. 1); antennae with 7 or more segments (figs. 6 and 7). (Tribe, *Cerealcini* trib. nov.) .. 2.

—. Maxillary palp 4-segmented; labial palp 3-segmented (fig. 2); both of equal thickness; antenna with 6 or few segments (figs. 3, 4 and 5). .. .. (Tribe, *Pergini*) . . . . 3.

2. Clypeus flat; antennae (fig. 7) with 8 or more segments and longer than the breadth of the head; segment 3 only about $1\frac{1}{2}$ times longer than 4 and much less than 4 plus 5. .. 1. *Cerealces* W. F. Kirby, 1882.

—. Clypeus with a transverse fold or ridge in the middle, the front $\frac{1}{2}$ of the clypeus being bent inwards; antenna (fig. 6) with 7 segments and shorter than breadth of head; segment 3 about as long as 4 plus 5. .. .. 2. *Xyloperga* Shipp, 1894 (= *Heptacola* Konow, 1905).

3. Antenna (figs. 4 and 5) shorter than breadth of head; segment 4 at most 3 times as long as broad, generally less than twice; segment 1 (funicle) not longer than broad, except in *Paraperga* Ashmead. 4.

—. Antenna (fig. 3) longer than breadth of head; segment 4 being at least 4 times as long as broad; funicle $1\frac{1}{2}$ times longer than broad. .. .. 8. *Acanthoperga* Shipp, 1894.

4. Either the radial cell of the forewing is broader than the greatest breadth of the stigma (figs. 9 and 11) or (certain ♂♂ of *Perga*) the malar space is shorter than the diameter of the front ocellus. . 5.

—. Radial cell of forewing at its greatest breadth not broader than the stigma (fig. 10) and the malar space is longer than the diameter of the front ocellus. . . . . 7. *Pseudoperga* Guérin, 1845.

5. Hind basitarsus shorter than the next 2 tarsal segments together (measured along upper surface). . . . . 6.

—. Hind basitarsus at least longer than the next 2 tarsal segments together. . . . . 7.

6. Basal segment of antenna cylindrical and much longer than broad (excluding radicle); 4th cubital cell little more than two-thirds as long as the other 3 cubital cells together. . . 5. *Paraperga* Ashmead, 1898.

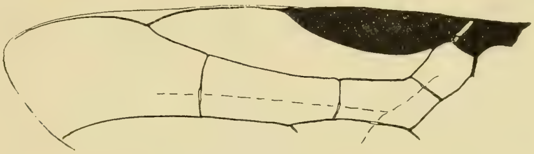


Fig. 8.

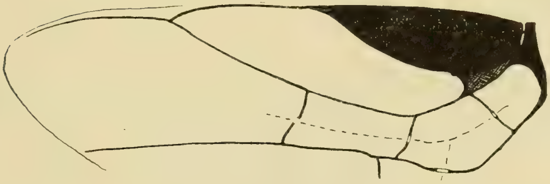


Fig. 9.

Fig. 10.

Fig. 11.

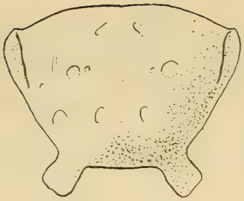


Fig. 12.

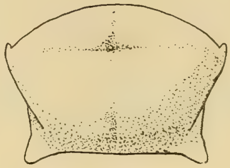


Fig. 13.

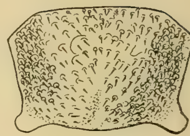


Fig. 14.

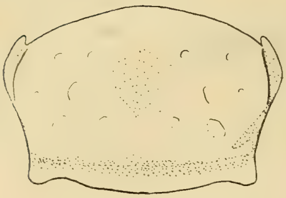


Fig. 15.

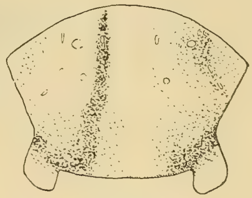


Fig. 16.

Fig. 17.

Fig. 18.

Fig. 19.

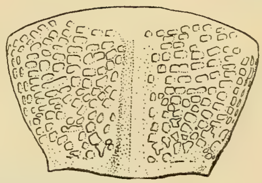


Fig. 20.

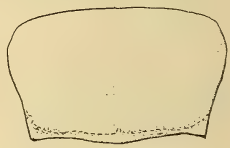


Fig. 21.

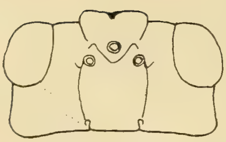


Fig. 22.

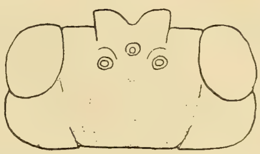


Fig. 23.

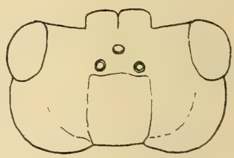


Fig. 24.

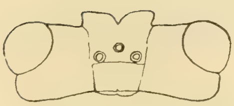


Fig. 25.

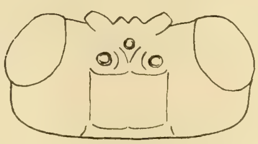


Fig. 26.

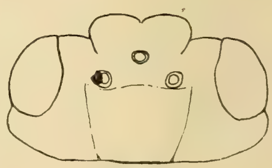


Fig. 27.

—. Basal segment of antenna about as broad as long; 4th cubital cell about as long as the other 3 together. .. .. .. 6. *Antiperga* gen. nov.

7. Hind lobes of scutellum very short, not reaching backwards as far as the middle of the hind margin of the scutellum (figs. 19, 20 and 21). . . . . 3. *Perga* Leach, 1817.

—. Hind lobes of scutellum well developed and clearly reaching further back than the middle of the hind margin of the scutellum (figs. 16, 17 and 18). .. . . 4. *Pergagrapta* gen. nov.

1. Cerealces W. F. Kirby, 1882.

Redescription: Head subparallel sided; mouth parts as in fig. 1; maxillary palp slender and 6-segmented; labial palp 4-segmented and nearly twice as broad as maxillary palp; clypeus flat; malar space less than length of pedicel of antenna; antenna (fig. 7) 8-12 segmented and considerably greater in length than breadth of head (♀ 4.5 mm. = 3.5 mm.; ♂ 4 mm. = 3 mm.); funicle (segment 1) excluding radicle, as broad as long; segment 3 at most only about one and a half times longer than 4 and much less than straight vertical furrows; pol about equal to gol.

Thorax: Scutellum convex with a definite longitudinal median groove; strongly narrowed behind, the hind margin being little longer than the 4 plus 5; postocellar area punctured, convex and margined with nearly side; hind lobes well developed.

Wings with a small stigma less than half as broad or long as radial cell; 3rd cubital cross-vein of forewings almost straight and directed to a point well outside the apex of the stigma; 4th cubital cell only about two-thirds as long as the rest of the cubital cells together; basal and 1st recurrent veins subparallel; males without a hairy patch.

Legs with only simple hairs on fore tibia; hind tibia with a broad apex so that the exposed part of the short basitarsus is in the ♀ no longer than the apical breadth of tibia, while in the ♂ it is about one and a half times as long; hind tarsal segments together about half as long as tibia in ♀ and two-thirds in ♂.

Abdomen broad and tapering behind in ♀; dull above with transverse rugulae; ♀ sawsheath projecting slightly and viewed from above is incrassate towards the apex where it is truncate, but bears beneath at its base only simple hairs. Monotypical. Type, *Cerealces scutellata* W. F. Kirby, 1882.

Cerealces scutellata W. F. Kirby, 1882, p. 31, and *C. cyathiformis* W. F. Kirby, 1893, p. 42, are both males of the same species. The male, according to Morice (1919), has 10-12 segmented antennae. The unique type of *C. scutellata* has actually only 8 complete segments to the antenna; the last segment forming the club is twice constricted to make three lobes, but the lobes are not actually divided into separate segments. In the female, however, the antenna, except that it has one more segment, is not unlike that of the typical *Xyloperga*.

The species is strikingly coloured, being black with more or less rufous scutellum and antennae, and with the following parts yellowish white; clypeus, inner and outer orbits, hind angles of pronotum, tarsi of all legs and tibiae except sometimes on the outer side apically, femur at least on the hind legs beneath, trochanters of middle and hind legs, with the abdominal terga 2 and 6 in the ♀ and in the ♂ terga 2 and the apical ones

from 7 onwards. The wings are yellowish hyaline with an infuscate stigma and venation. Length, 9-13 mm. The female is described in detail by Forsius (1927, pp. 299-300). The saw is illustrated in fig. 33. New South Wales, Victoria and South Australia.

2. Xyloperga Shipp, 1894.

Redescription: Head subparallel-sided or swollen behind the eyes; clypeus with a transverse fold, the front ½ being flat and the basal ½ convex; palps (fig. 1) as in *Cerealces*; malar space equal to or shorter than pedicel of antenna; antenna subclavate, 7-segmented and less in length than breadth of head; segment 3 about equal to 4 plus 5; flagellum slightly shorter than distance between the eyes; postocellar punctured in the middle (except in *amenaida* W. F. Kirby), with clearly defined straight vertical furrows in the *perkinsi* group and outwardly curving furrows in the *halidaii* group; POL greater than OOL.

Thorax as in *Cerealces* but the median groove to the scutellum may be absent.

Wings as in *Cerealces* but that the ♂♂ have a hairy patch on the underside of the medial, 1st cubital and 1st discoidal cells of the forewing.

Legs except in *amenaida* W. F. Kirby bearing only simple hairs on the front tibia; hind tarsal segments ½ to ¾ as long as hind tibia; basitarsus about 1½ times as long as the apical breadth of the tibia.

Abdomen as in *Cerealces*. Type, *Perga halidaii* Westwood, 1880.

Perga jucunda W. F. Kirby, was placed by Morice in this genus, for what reason he does not say. The type has the mouthparts of a typical *Pergine,* but owing to its peculiar antennae, scutellum and hind tarsi it is being separated into a separate genus *Paraperga* Ashmead.

Key to Xyloperga Shipp.

1. Postocellar region not clearly defined (fig. 23); the vertical furrows almost obsolete; secondary furrows however curve outwards from the vertex and reach to the eyes. . . . . 2.

—. Postocellar region clearly defined by almost straight and parallel vertical furrows reaching from the vertex to just outside the hind ocelli (fig. 22). [Saw tooth with few and large secondary teeth (fig. 34); hind basitarsus only as long as apex of hind tibia.] . . . . . . 6.

2. Postocellar region of head densely punctured; exposed part of hind basitarsus longer than breadth of apex of hind tibia and more than twice as long as its own apical breadth; front tibia without incrassate hairs; ♀ saw with large teeth bearing numerous fine secondary teeth (figs. 36 and 37). . . . . 3.

—. Postocellar region of head unpunctured in the middle; exposed part of hind basitarsus only as long as breadth of apex of tibia and scarcely 1½ times its own apical breadth; front tibia with some incrassate hairs on its inner surface towards the apex as in typical *Pergini*; ♀ saw with numerous primary teeth (fig. 35). [With the light coloured parts that is the legs, venter, face, antennae, scutellum, margin of pronotum, etc., orange; costa and stigma black; ♂ with the light parts yellowish white; costa and stigma yellow; scaly patch of forewing occupies subcostal and first cubital cells.] South Australia, ♂ and ♀. . . . . *amenaida* (W. F. Kirby, 1882) (= *rufomaculata* W. F. Kirby, 1882).

3. Hind femora black on the inside at least at the apex. . . . . . . 4.

—. Hind femora not marked with black. . . . . 5.

4. At least funicle and pedicel of antenna with most of the hind and middle femora and apex of hind tibia and in ♀ also costa, basal and median veins black. Side lobes of mesonotum sparsely punctured behind, with shining areas between punctures; scutellum densely punctured and with a medial longitudinal depression. [Bluish black species with only the face, orbits, vertical stripes, edges of mesonotal lobes, with or without scutellum, a band along the middle of the mesopleura, a spot on the side of each abdominal tergum, and more or less the sterna, trochanters, base of tibia and tarsal segment yellow; ♀ with at least strongly infuscate apex to forewing.] Victoria, ♂ and ♀. . . . . *lalage* (W. F. Kirby, 1892) (= *buyssoni* Konow, 1905).

—. With antenna and base of hind and middle femora and in ♀ also costa, stigma, basal and median veins, yellow (in ♂ the costa and stigma may be tinged with grey); side lobes of mesonotum densely punctured, without any large shining areas between the punctures; scutellum hardly punctured but without medial longitudinal depression. [Species very variable in colour may be entirely yellow except for the dark hind femur and apex to hind tibia, or may be more or less dark brown or bluish black marked; in the darkest specimen before me there are three dark transverse stripes on the back of the head and the pronotum (except the hind margins), the mesonotum (except the side margins and the scutellum), the mesopleura except for a transverse lateral band, and the whole of the dorsum of the abdomen are bluish black. This is the form thought by Morice, 1919, to be the ♀ of *lalage* (Kirby). Saw fig. 36.] North Queensland, ♂ and ♀. . . . . *univittata* (W. F. Kirby, 1882).

5. Basal and median veins of forewing dark brown; head without a shiny patch just behind the hind ocelli. [Species variable in colour, dark brown or bluish black with the face, orbits, antennae, vertical stripes, margins of pronotum and of side lobes of mesonotum, scutellum, broken band across pleurae, legs and underside of abdomen yellow.] New South Wales and Victoria. ♀. . . . . *leachii* (Westwood, 1880).

—. Basal and median veins of forewing yellow as the other veins; head with a conspicuous shiny unpunctured patch just behind and outside the hind ocelli, usually at the front of the pale vertical stripe. [♂ and ♀ coloured as in *X. leachii* W. F. Kirby, except for forewings; saw as in fig. 37.]. Victoria. . . . . *halidaii* (West,wood, 1880) (= *jurinei* Westwood, 1880).

6. Postocellar region shining in the middle between sparse punctures. . . . . 7.

—. Postocellar region dull and densely punctured in the middle. . . 8.

7. Antenna, clypeus, postocellar region and all of the legs, black; wings smoky black with black stigma and venation. [Entirely black except for the labrum, the hind orbits and temples, a spot on the middle of the mesopleurae and a line on each side of the dorsum of the abdomen extending from segments 3 to 8. Mesopleura sparsely punctured; POL = OOL as in 24:21. ♀., 17.5 mm.] New South Wales. . . . . *mocsaryi* Konow, 1905.

—. Antenna, clypeus, vertical area and legs, except middle and hind coxae, yellow; wings yellowish with stigma and venation brown. [Ochreous-yellow with black on the ocellar region, the mesonotum (excluding the scutellum), the mesosternum, the sterna of abdomen, and more or less the basal and other terga; saw as in fig. 34; ♂ coloured as in the ♀ except that the whole of the venter is pale; the abdomen above is steely blue; the stigma is yellowish brown (less dark than ♀).] South and West Australia, ♂ and ♀. .. .. *perkinsi* Benson, 1935.

8. Mesopleura smooth, shining and with very few sparse punctures. .. .. 9.

—. Mesopleura dull, with rough rugulous surface. [Mostly yellow species, except for the antenna, spot in middle of pronotum, front lobe of mesonotum, mesosternum, spot on mesepisternum, another or metapleura and on base of hind coxa, hind femur, and apex of middle and hind tibiae, first tergum and a spot on each side of each of the following terga, just above the stigma, all of which are black. Wings yellow; stigma and venation yellow. POL:OOL as 26:20; ♀ saw Morice (Pl. xv., fig. 12); ♂ unknown.] Queensland, North and Central Australia. ♀. .. .. *aurulenta* Morice, 1919.

9. Hind femur and generally tibia entirely pale. .. .. 10.

—. Hind femur and tibia at least marked with black at apex. [Antenna entirely black; costa and stigma brownish in ♀ (♂ unknown); forewings brownish throughout with black basal and median veins; vertical furrows run from vertex towards the hind ocelli, and are deep in the vertical region; the postocellar area is coarsely punctured with irregular intervening shining areas. Purplish metallic species, with face, temples, upper two-thirds of mesopleura, hind margin of pronotum, margin of side lobes of mesonotum, scutellum, legs (except for inner apex of hind femur, and apex of hind tibia) and sides of abdomen yellow.]. South Australia, ♀. .. .. *dentata* (W. F. Kirby, 1883).

10. Flagellum of antenna black; mesopleura black with a large white spot or band across the middle. Scutellum shining, sparsely punctured, glabrous; distance between eye and hind ocellus, less than the distance between the two hind ocelli (POL:OOL as about 10:9). South-West Australia, ♀. .. .. *semipurpurata* Morice, 1919.

—. Flagellum of antenna yellow; mesopleura white except near the suture dividing it from the mesosternum; scutellum dull, with dense fine punctures, each bearing a short black hair; distance between eye and hind ocellus greater than the distance between the two hind ocelli (POL:OOL as about 11:12). New South Wales and Victoria, ♀. .. .. *forsiusi* sp. nov.

XYLOPERGA FORSIUSI *sp. nov.*

♀. Colour yellow with the following parts blue-black: apex of mandible, suture behind clypeus, semi-circular black mark surrounding the ocelli in front, a spot between the vertical furrow and the eye, and one in the middle of the postocellar region, the funicle and pedicel of antenna, spot in the middle of the pronotum, the mesonotum (except for a spot each side of the front lobe, the raised edge on the side of the side lobes), a medial stripe on the scutellum, the mesosternum and lower part of mesopleura adjoining it, a spot at the base of each coxa, the dorsal parts

of the abdomen. Wings yellowish-hyaline, more deeply yellow at base of forewing; stigma costa and venation yellow.

Length, 17.5 mm.; antenna, 3.2 mm.

Head on dorsal surface (except behind the eyes) covered with fine regular punctures which in the frontal area and postocellar region each bear a black hair; between the punctures are small shining spaces.

Thorax with pronotum punctured with small vague shallow punctures; front lobe of mesonotum densely and heavily punctured, dull; side lobes of mesonotum irregularly and coarsely punctured, with shining interspaces especially behind; scutellum dull with dense fine punctures each bearing a short black hair, but with unpunctured interspaces; under-thorax smooth and shining with a few scattered irregular coarse punctures, and except for the mesopleura, which are glabrous, with scattered pale hairs.

Abdomen and other parts normal; saw as in figure 34. Australia, Victoria, 1 ♀ (holotype), no other data (National Museum, Victoria); Canberra, F.C.T., 1 ♀ (paratype), 8.XI.1929, G. A. Waterhouse (Canberra Museum).

Perga Leach, 1817.

Redescription: Head when viewed from above, shorter behind the eyes than the length of an eye from that viewpoint (figs. 26 and 27); maxillary palp 4-segmented; labial palp 3-segmented; both of equal thickness; clypeus flat or with inflexed front margin; malar space usually less than diameter of front ocellus; antenna (figs. 4 and 5), 5-6 segmented, clavate, shorter than breadth of head; funicle (excluding radicle) as broad as long; segment 3 little longer than 4; segment 4 at most under 3 times as long as broad and often broader than long; POL:OOL varying, but greater in ♂♂ than ♀♀; postocellar area raised well above the temples each side and margined with subparallel vertical furrows in the *dorsalis* and *kirbyi* groups while in the *dahlbomii* group the area is more roundedly convex, often almost hemispherical with vague curved vertical furrows.

Thorax: Scutellum generally flat or slightly convex, with at most, only a slight medial depression (figs. 19, 20 and 21); hind lobes scarcely developed or at most not reaching backwards as far as does the middle of the hind margin of the scutellum.

Wings (fig. 11) with a stigma varying in breadth but, except in ♂♂ of the *dahlbomii* group, clearly narrower than the radial cell; stigma ½ to 2/3rds as long as radial cell; 3rd cubital cross-vein of forewing strongly curved or angled and directed towards a point on the stigma at least 1/3rd from the apex; 4th cubital cell longer than the rest of the cubital cells together; ♂♂ with a specialised patch of hairs on the underside of the forewing generally more or less developed.

Legs with the fore tibia bearing a few incrassate hairs on the inside towards the apex; hind basitarsus at least as long as the 3 following tarsal segments together; hind tarsi together not more than 2/3rd the length of the hind tibia; 5th hind tarsal segment greater than 3 plus 4.

Abdomen stout and in ♀ tapering slightly apically; often dull above with minute transverse rugulae; ♀ sawsheath incrassate apically and in the *dorsalis* group densely covered with stout incrassate bristles (figs. 28 to 31); saw much as in fig. 39 except in the *dahlbomii* group which have saws

as in fig. 38; ♂ abdomen in some species of *dorsalis* group densely pubescent above on the basal segments. Type: *Perga dorsalis* Leach 1817.

Key to Perga species.

1. Antenna or at least flagellum of antenna shorter than front margin of clypeus; frontal crests above bases of antennae very swollen and so large that the distance between them is at most the same as the breadth of one of them. . . . . 9.

—. Flagellum much longer than front margin of clypeus; frontal crests small and much further apart than the breadth of one. . . . . 2.

2. Scutellum shorter than its breadth behind (measured from the middle of the base of each hind lobe) (fig. 19); ♀ sawsheath clothed each side with a very dense brush of bristle, which may be incrassate or toothed apically; wings at least partly infuscate flavescent; body metallic green, blue or brown. . . . . 3.

—. Scutellum narrowed behind so that it is at least as long as its breadth behind (fig. 20); ♀ sawsheath with only sparse and very fine hairs each side; wings hyaline; body entirely brown. . . . . 7.

3. Mesopleura in the middle dull and rugged with coarse confluent punctures; ♂ abdomen basally densely pubescent above; mostly green species; incrassate bristles on ♀ sawsheath rounded apically without teeth (figs. 30 and 31). . . . . 4.

—. Mesopleura in the middle shining with round even-spaced punctures, not confluent; ♂ abdomen with at most very fine short sparse pubescence; species brown, or metallic blue or brown with metallic reflections; incrassate bristles on ♀ sawsheath with apical teeth (fig. 32) . . . . 5.

4. Female sawsheath with extreme apices of the valves diverging when viewed from beneath (fig. 29); sides of the sheath bearing bristles that are almost racket-shaped (fig. 31); hind basitarsus is about as long as the three following tarsal segments together; the next-to-last tarsal segment is clearly longer than broad; hind ocelli closer together so that POL is less than OOL, and the postocellar region is longer than its breadth in front, so that POL is only about half as long as the distance between the hind ocellus and the hind margin of the head; wings yellowish-brown infuscate; saw (Morice, pl. xiv., fig. 1). ♀. See below. Queensland and New South Wales. . . . . . *dorsalis* Leach, 1817. (= ? *eucalypti* Bennet and Scott, 1855, ? *scotti* Bennet, 1860, *scutellata* Westwood, 1845, and *intricans* Morice, 1919, in parte.)

—. Female sawsheath with the extreme apices of the valves converging (fig. 28); bristles on the sides of the sheath less swollen (fig. 30); hind basitarsus is greater than the three following tarsal segments together and almost as long as the four following tarsal segments; hind ocelli further apart so that POL is greater than OOL; postocellar region is shorter than its breadth in front, so that POL is as much as two-thirds the distance between a hind ocellus and the hind margin of the head; wings yellowish; saw (fig. 39). [The males of these two species do not exhibit to the same degree the differences in the distances between the ocelli, the form of the vertical area and proportions of the tarsal segments that can be used for separating the females. Unfortunately the types of both *P. dorsalis* Leach and *P. affinis* W. F. Kirby are males,

and it is by no means altogether certain that the females have been correctly associated with these males; I have had to rely to a large extent on the depth of wing infuscation and the locality. Even the male genitalia have so far yielded no reliable characters for separating the male material at my disposal into two species corresponding with the females. The larva of what is probably *Perga dorsalis* Leach, was described by Bennet and Scott (1859) on "*Eucalyptus citriodora* Hooker" and by Froggatt (1890 and 1891) on "*Eucalyptus corymbosa, E. citriodora, E. novaeangliae,* etc." Detailed accounts of the colonial habits of the larvae of this species are given by Froggatt (1918), while the account given by Ross (1929) from Victoria and Evans (1934) from South Australia, probably refer to *P. affinis* W. F. Kirby; Evans (p. 438) mentions that his larvae were found on *Eucalyptus obliqua* and refused to eat *E. odorata* and *E. leucoxylon;* young larvae were starved into feeding on *E. rostrata* in captivity, but that older larvae died of starvation rather than feed on this tree.] Victoria and South Australia. .. .. *affinis* W. F. Kirby, 1882 (= *intricans* Morice, 1919, in parte).

5. Antenna and legs for most part brown; wings slightly brownish; head above, mesonotum and abdomen at least partly brown though maybe with chalybeous reflections; stigma ½ as long as radial cell in forewing .. .. 6.

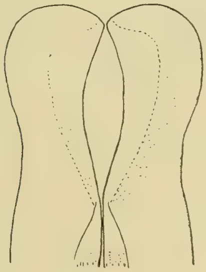


Fig. 28.

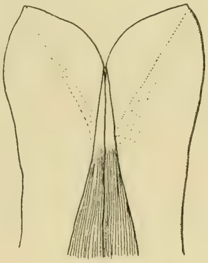


Fig. 29.

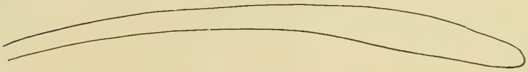


Fig. 30.

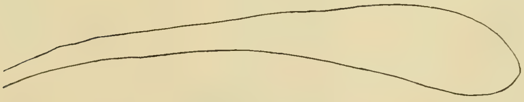


Fig. 31.

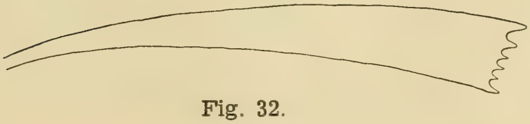


Fig. 32.

—. Antenna and legs for most part bluish-black; wings mostly smoky black; head above, mesonotum (except scutellum) and abdomen metallic blue; stigma about 2/3rds as long as radial cell. (Associated with mallee scrub of inner South and West Australia.) . . *konowi* sp. nov.

6. Hind tibia with the apical third black; side lobes of mesonotum and abdomen more or less chalybeous. [Saw Morice, plate xiv., fig. 6. South Western Australia, ♂♀.] . . . . *schiödtei* Westwood, 1880.

—. Hind tibia not black apically; thorax and abdomen not at all chalybeous. [Saw Morice, plate xiv., fig. 4. South Western Australia, ♂♀.] . . . . *klugii* Westwood, 1880.

7. Mesopleura above dull and rugulously punctured; radial cell in hind wing about as far from apex of wing as half its own length. . . 8.

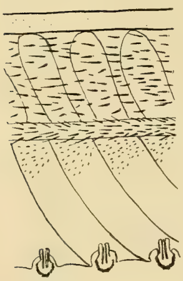


Fig. 33.

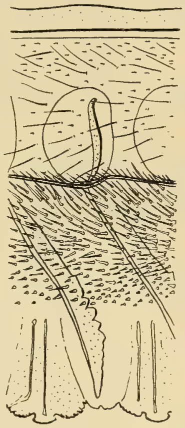


Fig. 34.

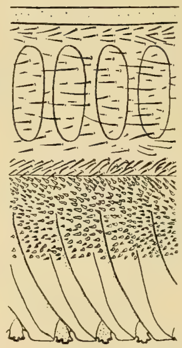


Fig. 35.

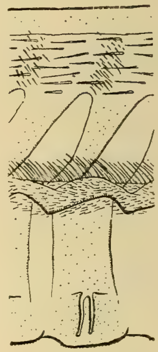


Fig. 36.

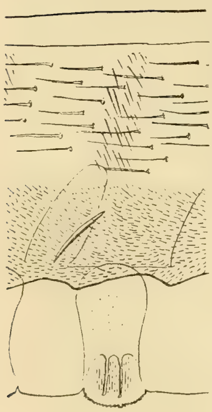


Fig. 37.

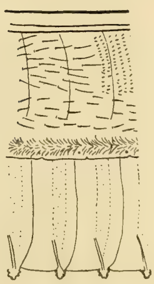


Fig. 38.

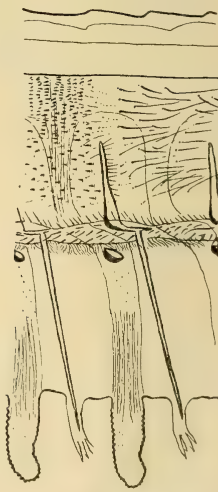


Fig. 39.

—. Mesopleura shining between remote punctures; scutellum with a few vague punctures and bisected by a vague longitudinal depression in the middle; hind tarsi together only about half as long as hind tibia; radial cell in hind wing longer so that it is closer to the apex of the wing than half its own length. [Saw Morice, plate xiv., fig. 8. South West and South Australia, ♀.] .. .. *brevitarsis* Morice, 1919.

8. Mesonotum dull all over with rugulous surface; scutellum closely and coarsely punctured all over (fig. 20); hind basitarsus equal in length to the three following tarsal segments together; POL less than OOL. [Saw Morice, plate xiv., fig. 5. Victoria and South Australia, ♂ and ♀.] .. .. *kirbii* Leach, 1817.

—. Mesonotum dull in front, but shining on the sidelobes, especially behind; scutellum with small scattered punctures separated by smooth shining spaces; hind basitarsus greater in length than the three following tarsal segments together; POL greater than OOL. [Saw Morice, plate xiv., fig. 3. Victoria ♂ and ♀.] .. .. *agnata* Morice, 1919.

9. Antennae longer than the distance between their insertions. [Abdomen yellow, more or less marked with meatllic bluish-black above.] 10.

—. Antennae shorter than the distance between their insertions. . 11.

10. Head and thorax including mesopleura and mesosternum covered with long brown hairs; hind tarsi together ½ length of hind tibia; flagellum of antenna 1¼ times as long as distance between insertions of antenna; wings yellowish; head above yellow except for the neighbourhood of the ocelli and mesonotum yellow except for at most a macula on each lobe. 17-21 mm. South Australia, ♀. .. .. *brevipes* Forsius, 1927.

—. Head and thorax with short pubescence; mesopleura and sternum glabrous; hind tarsi together less than ½ length of hind tibia (in proportions of about 7:18); flagellum of antenna equal in length to the distance between the insertions of the antennae; wings clear hyaline; head above and mesonotum (except for scutellum) black. 19 mm. South Australia, ♀. .. .. *waiti* Forsius, 1927.

11. Front margin of the clypeus inflexed in the middle; ♀ hind tarsi less than ½ length of hind tibia; antenna pale .. .. 12.

—. Clypeus flat, without an inflexed front margin; either ♀ hind tarsi are more than ½ length of hind tibia, or else the antenna is black. 13.

12. Forewing at the most only slightly cloudy apically; radial cell and base always clear. [♀ bluish black; clypeus, labrum, antenna, outer orbits, margin of pronotum, scutellum band on mesopleura, apex of femora, whole of tibiae and tarsi white; abdomen may be reddish on the middle segments; ♂ as in ♀ but with abdomen and legs entirely pale. Saw (Morice, plate xv., fig. 1). South and Western Australia. ♂♀.] .. *brullei* Westwood, 1880 (= *cressonii* Westwood, 1880, *ritsemei* Westwood, 1880, *dubia* W. F. Kirby, 1882, and *vacillans* Morice, 1919).

—. Apex of forewing, including radial cell, densely smoky; base clear. [♀ coloured otherwise as in *brullei*; ♂ unknown.] Queensland and Western Australia, ♀. .. .. *christii* Westwood, 1880.

13. Antenna and clypeus black; ♀ hind tarsi about ½ length of hind tibia. .. .. 16.

—. Antenna and clypeus pale; ♀ hind tarsi more than ½ length of hind tibia. . . . . 14.

14. Head, pronotum and abdomen in part yellow; wings flavescent with brown stigma and costa. . . . . 15.

—. Head above, thorax and abdomen entirely black; wings almost hyaline with stigma and costa black. [Black; clypeus, face, antennae, tibiae and tarsi of all legs, femur of front legs yellow; ♂ unknown.] Queensland ♀. . . . . *kohli* Konow, 1905 (= *thomsoni* Benson, 1935).

15. Front portion of middle lobe of mesonotum dull and rough with dense puncturation; ♀ mesonotum to a large extent, including entire scutellum also sterna of abdomen, black. [♂ has pale scutellum. Saw (Morice, plate xiv., fig. 12).] North Queensland (Cape York) to New South Wales, ♂♀. . . . . *vollenhovii* Westwood, 1880 (= *walkeri* Westwood, 1880).

—. Front portion of middle lobe of mesonotum with shining interspaces between scattered punctures; ♀ mesonotum, scutellum in part and sterna of abdomen brown. [♂ unknown. Western Australia, ♀.] . . . . *mayrii* Westwood, 1880 (= *bisecta* W. F. Kirby, 1882).

16. Legs and frontal crests entirely black; forewings with apical 2/3rds brownish infuscate; abdomen shining above with faint rugulous sculpture becoming obsolete on base and apex of each tergum. Blue Mountains, New South Wales, ♀. . . . . *bradleyi* sp. nov.

—. Legs with the following parts yellowish white; apices of all femora, tibiae except apex of hind pair and basal tarsal segments of front and middle pair; frontal crests white marked; forewings with at most apical 1/3rd slightly yellowish; abdomen dull above all over with dense rugulous sculpture. Queensland, ♂♀. . . . . . . *dahlbomii* Westwood, 1880.

PERGA KONOWI, *sp. nov.*

♂♀. Colour bluish black with the following parts yellow; clypeus more or less, frontal crests, a thin strip on inner orbits and a spot behind the temples each side.

Wings smoky black, less dense at the base of the hindwing; in the ♂ the basal 1/3rd of the forewing and 2/3rds of the hindwing are clear; stigma brown; venation blackish brown.

Length: ♀, 20-22 mm.; forewing, 17 mm.; antenna, 3 mm.
♂, 18 mm.; forewing, 15 mm.; antenna, 3 mm.

Pubescence almost obsolete on head, thorax and dorsum of abdomen.

Head shining but with dense punctures on temples; punctures sparse and widely separated on hind orbits, vague and obsolete on clypeus, labrum and postocellar region; labrum obtusely rounded in front; clypeus flat almost truncate in front, very slightly emarginate in the middle; flagellum of antenna about as long as distance between the eyes; malar space a little shorter than the pedicel of the antenna; postocellar region about as broad as long, parallel sided and raised above the level of the temples on each side; POL equal to or slightly less than OOL and hind ocelli much closer together than the distance of one from the hind margin; frontal crests wider apart than the breadth of one; supra clypeal area with a medial longitudinal groove.

Thorax: Pronotum with regular widely-spaced punctures; mesonotum

coarsely and densely punctured, especially in the front and middle, where many of the punctures are confluent, but unpunctured interspaces are present, especially on side and hind parts of side lobes; scutellum, shining with very vague coarse punctures, only slightly convex, and considerably broader behind than long (about 4:3); mesopleura with mesepisternum regularly and evenly punctured on the upper $\frac{3}{4}$; punctures in the middle are separated and not confluent, though in the front and below some of the punctures are almost contiguous; surface between punctures and on other parts of pleura are smooth and shining with only vague sculpture; tarsi of hind leg together equal to about 2/3rds length of tibia; basitarsus greater than length of three and nearly as long as four following tarsal segments together.

Abdomen with the terga transversely rugulous; terga 1, 8 and 9 with a few scattered punctures. ♀. Sawsheath bearing hairs that are incrassate apically and toothed at the end (fig. 32). Saw as in *P. affinis* W. F. Kirby (fig. 39).

New South Wales: Euston "Mallee scrub", bred from larvae on *Eucalyptus transcontinentalis* Maiden, in 1933. 1♀ (holotype), 1♂ (allotype) in British Museum, 2♀♀ in Australian Museum, Sydney (W. W. Froggatt).

South Western Australia: Narrogin, 1♀ (Perth Museum, 1934—1226). (Has yellow labrum, front tibia, except base, middle basal portion of middle and hind tibiae, bases of front and middle tarsal segments and spot on mesepisternum; puncturation heavier than in type.)

North Western Australia: Raeburn, 1♀ (Perth Museum, 1922—680). (Has POL greater than OOL and front orbits yellow margined.)

PERGA BRADLEYI, *sp. nov.*

♂. Colour bluish black with the pronotum, scutellum and a spot on the hind orbit yellowish white.

Wings: Apical 2/3rds of forewings fuscous, base of the same and hindwings almost hyaline; stigma and venation piceous.

Length: 16.5 mm.; forewing, 13.5 mm.; antenna, 1.4 mm.

Pubescence on thorax and abdomen (except 1st tergum) very sparse.

Head shining with coarse punctures above the antennae especially in and bordering the depressions; there are, however, shining interspaces between the punctures especially on the raised portions such as the middle of the postocellar region and also on the hind orbits; clypeus slightly emarginate in the middle; flagellum of antenna about as long as the distance between the antennal sockets; malar space as long as pedicel of antenna; segments 4 and 5 of antenna about twice as broad as long; distance between eyes greater than length of an eye; frontal crests large and broad so that the distance between them is about $\frac{1}{2}$ the breadth of one; postocellar area convex with vague curved vertical furrows; breadth to length of postocellar area in proportion of about 4:3; POL = OOL; distance between hind ocelli about $\frac{1}{2}$ distance of one from hind margin of head.

Thorax shining with coarse dense puncture in the middle of the front lobe of the mesonotum and the middle of each of the side lobes; a few scattered punctures occur on the pronotum, the sides of the scutellum and the middle of the mesopleura; scutellum a little shorter in the middle than

the breadth of the hind margin; hind tarsi about ½ as long as hind tibia; basitarsus longer than next 2 tarsal segments together.

Abdomen shining with faint transverse rugulous sculpture especially on the upperside in the middle of each tergum; apex and base of middle terga unpunctured; saw much as in fig. 39.

New South Wales: Blue Mountains, 1 ♀ (A. Musgrave), "*Perga dahlbomii* Westwood, ♀", id., by R. J. Tillyard" (Australian Museum).

PERGAGRAPTA, *gen. nov.*

Head as in *Perga* except that the antenna is never shorter than the distance between the eyes and never longer than the breadth of the head; POL is generally less than OOL, the postocellar is convex and defined by subparallel vertical furrows except in the *spinolae* and *bella* groups where the head is almost flat behind.

Thorax; Scutellum (figs. 16, 17 and 18) generally with well developed hind lobes which at least reach back beyond the level of the middle of the hind margin of the scutellum; scutellum with a medial longitudinal furrow at least indicated and in the *castanea* group very deep and clear.

Wings (as in figs. 9 and 11) with stigma always much narrower than radial cell of forewing and ½ to 2/3rds as long as radial cell; 3rd cubital cross-vein of forewing strongly angled in the *castanea* and *esenbeckii* groups but nearly straight in the *spinolae* and *bella* groups, so that here it is usually directed actually to the apex of the stigma; 4th cubital cell longer than the rest of the cubital cells together; ♂♂ may or may not have special hairy patches on the underside of the forewings.

Legs and abdomen as in *Perga* except that in no species have incrassate hairs been seen on the sawsheath; several of the ♂♂ have fine pubescence developed on the basal terga. Saw in the *castanea* group much as in fig. 39; in the *bella* group as in fig. 43; in *P. bicolor* Leach as in fig. 42; in the other much as in fig. 44. Type, *Perga bella* Newman.

Key to PERGAGRAPTA species.

1. 3rd cubital cross-vein almost straight and directed towards the apex of the stigma; scutellum with only a vague medial furrow. .. 2.

—. 3rd cubital cross-vein strongly angled and directed towards a point on the stigma about 1/3rd from its apex; scutellum divided medially by a distinct and deep furrow (*castanea* group). .. .. 4.

2. Mesopleura smooth between widely scattered punctures; cubital cell in hindwing only ½ to 2/3rds as long as the free end of the cubital vein. .. .. 3.

—. Mesopleura densely rugulously punctured in the middle; cubital cell in hindwing almost as long as the free end of the cubital vein (*bella* group). .. .. 10.

3. Postocellar area clearly defined laterally and convex so that it is raised above the level of the temples each side and when viewed from behind, the hind margin of the head is definitely curved (*glabra* group). 8.

—. Postocellar area not clearly margined laterally and flat so that when viewed from behind, the hind margin of the head appears almost as a straight line (*spinolae* group). .. .. 14.

4. Mesopleura shining between large clearly defined punctures; pronotum, scutellum and mesopleura of the same chestnut brown colour as the rest of the thorax; cubital cell in hindwing as long as the apical free end of the cubital vein; ♂ with black hairy patches very conspicuous in the 1st cubital cell of both wings. [Legs entirely yellowish white; apical half of forewing strongly suffused with brown; basal half and hindwing slightly yellowish. Postocellar area about as long as broad; upper part of head, pronotum and front of mesonotum dull with dense punctures and short black hairs, but there is a shiny patch on the temples just each side of the vertical furrow behind; saw Morice, plate xiv., fig. 10.] New South Wales and Victoria, ♂ and ♀. . . . . *castanea* W. F. Kirby, 1882.

—. Mesopleura above dull with dense rugulous punctures; pronotum, scutellum and mesopleura yellowish white in contrast to the rest of the thorax which is brown; cubital cell in hindwing much shorter than the apical free end of the cubital vein; ♂ with hairy patch well marked in the 1st cubital cell of the forewing but absent from the hindwing. [The larva of one of the species in this group was described by Froggatt (1890, p. 285).] . . . . 5.

5. Postocellar area longer than broad and of the same breadth behind as in front; upper part of head dull with very small punctures set close together and evenly. [Hind basitarsus about equal to the following tarsal segments together; mesonotum densely punctured, especially pronotum which is covered with very fine punctures. Pronotum with side angles white; abdomen showing metallic gleam in ♀; wings densely suffused with yellow; hind femur dark chestnut; tibiae and tarsi yellowish white; saw Morice, plate xiv., fig. 9.] South Queensland, ♂ and ♀. . . . . *polita* Leach, 1817.

—. Postocellar area as broad as long and broader behind than in front; upper part of head with fewer punctures and these are concentrated mostly near the lateral furrows, leaving unpunctured spaces in the middle of the postocellar area and the sides of the temples. . . 6.

6. Hind basitarsus about as long as the rest of the tarsal segments together; wings strongly yellow infuscate throughout; mesonotum behind shining with widely spaced punctures; head behind very shining with scattered punctures. [Postocellar area about as long as broad.] South Australia, ♂ and ♀. . . . . *condei* sp. nov.

—. Hind basitarsus shorter than the length of the rest of the tarsal segments together; wings almost hyaline; mesonotum in the middle, just in front of the scutellum, dull with dense punctures and surface roughness. . . . . 7.

7. Postocellar area as long as broad; pronotum with the lower front half brown; hind tibia brown on apical $\frac{1}{4}$; ♀ forewing with a brownish infuscation just under the stigma; ♂ with a slight infuscation in the cubital cell of the hindwing. [This species and the one that follows may be considered later as only geographical races of one species.] North Queensland, ♂ and ♀. *turneri* sp. nov.

—. Postocellar area broader than long; pronotum entirely pale except for a spot at the front; hind tibiae not brown on apical $\frac{1}{4}$; ♀ forewing equally yellowish hyaline without any infuscate patch under the

stigma; ♂ without any infuscation in hindwing. Victoria, ♂ and ♀. .. .. *hackeri* sp. nov.

8. Basal tergites of abdomen shining, with rugulous sculpture almost absolete; hind basitarsus clearly longer than 3 following tarsal segments together. .. .. 9.

—. Basal tergites dull with strong rugulous sculpturation; hind basitarsus not longer than 3 following tarsal segments together. [Abdomen red, except the base and apex which are black; head with antenna, femora and stigma or wings black; hind tibia and tarsi red; forewing brownish infuscate in apical half, especially in radial cell, while the base and the hindwing are yellowish hyaline; saw Morice, plate xiv., fig. 11.] West Australia, ♀. .. .. *esenbeckii* Westwood, 1880.

9. Antenna and legs (except coxae) black; forewing equally brownish infuscate throughout. [Stigma black to brown; saw Morice, plate xv., fig. 4.] Queensland and New South Wales, ♀. .. *glabra* W. F. Kirby, 1882.

—. Antenna and legs (except hind tibia, base of hind tarsi and apex of hind femur) brown; forewing brownish infuscate in apical half only, the base being hyaline. [Stigma yellow; saw as in *glabra* W. F. Kirby. Perhaps a subspecies of *glabra* W. F. Kirby,] Victoria, ♀. .. .. *malaisei* sp. nov.

—. Basal vein in forewing yellow; without an unpunctured patch at the back of the vertical furrow bordering on the postocellar area. .. .. 11.

10. Basal vein in forewing black; each side of the postocellar area in the hind part of the vertical furrow there is at least a small unpunctured patch. [Varying in ground colour from forms entirely yellow to forms entirely black.] .. .. 12.

11. Abdomen yellow either entirely or more or less infuscate on the apical half; wings strongly yellowish, especially at the base; vertical furrows clearly defined; postocellar area U-shaped, and in front raised above the level of the temples each side. [Morice separated *P. hartigii* Westwood and *P. gravenhorstii* Westwood on trivial colour characters and on their supposed very distinct saws. (Morice, plate xv., figs. 8 and 9.) Two specimens in the British Museum named as *P. hartigii* Westwood by Morice have had their saws extracted and I have not been able to trace what became of the saws; a third specimen, agreeing with these two in every external character, had its saws intact and they agree exactly with those figured by Morice for *P. gravenhorstii* Westwood. It is most probable that *P. hartigii* Westwood is only a colour form of *P. gravenhorstii* Westwood, and that the saw illustrated by Morice as that of *P. hartigii* Westwood, really belonged to a specimen of some quite different species.] Victoria and New South Wales, ♂ and ♀. .. .. *gravenhorstii* Westwood, 1880 (? = *hartigii* Westwood, 1880).

—. Abdomen black, ornamented at the sides with creamy white patches, each patch occupying the middle of the part of the tergum that is bent over on to the ventral side; wings only yellowish hyaline; vertical furrows almost obsolete; postocellar region V-shaped, even in front hardly raised above the level of temples each side. New South Wales, ♀. .. .. *nigra* sp. nov.

12. Postocellar area and temples flat, shining and sparsely punctured with large shining interspaces; mesopleura densely punctured in the middle

but shining with sparse punctures at the sides; smaller species (12 mm.). Victoria, ♀. .. .. *rossi* sp. nov.

—. Postocellar area and temples dull and densely punctured in parts; mesopleura above irregularly punctured all over with dull rugulous surface between the punctures; larger species (14-20 mm.). .. 13.

13. Scutellum shining with large unpunctured areas at the sides behind, and the whole is convex so that the middle of the scutellum is clearly above the level of the top of the hind lobes (when viewed from the side). South Australia, ♀. .. .. *rohweri* sp. nov.

—. Scutellum irregularly punctured all over with a more conspicuous medial groove, so that the middle of the scutellum is more concave and is clearly below the level of the top of the hind lobes. [In this species there is considerable variation not only in colour, but also in the development of the crests between the antennae; saw (fig. 43 and Morice, plate xv., figs. 5, 6 and 7).] The larva was described by Froggatt, 1890, p. 288, as *Perga foersteri* Westwood, on *Eucalyptus corymbosa*. Victoria and New South Wales. .. .. *bella* Newman, 1831 (= *rubripes* Rohwer, 1910, and ? *montana* Forsius, 1935, *foesteri* Westwood, 1880, and .. .. *divaricata* W. F. Kirby, 1893).

14. Abdomen entirely black; scutellum (fig. 17) unpunctured and in shape more convex behind so that (viewed from the side) the middle is raised up well above the height of the tops of the hind lobes; costa and stigma black. [Saw (Morice, plate xv., fig. 10). The larva was described by Froggatt, 1890, p. 285, as *Perga chalybea* Froggatt, on "white gum".] Victoria. .. .. *bicolor* Leach, 1817.

—. Abdomen in part yellow or brown; scutellum (fig. 18) clearly punctured, and, in shape, more convex in front and flattened behind so

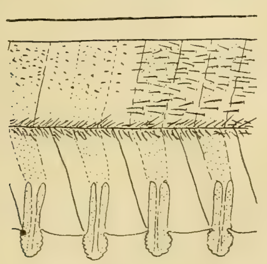


Fig. 40.

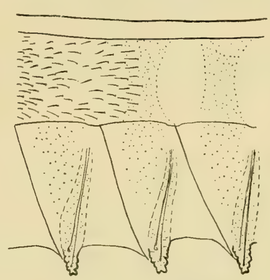


Fig. 41.

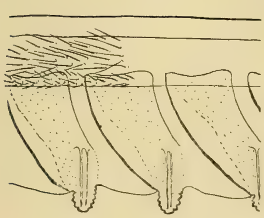


Fig. 42.

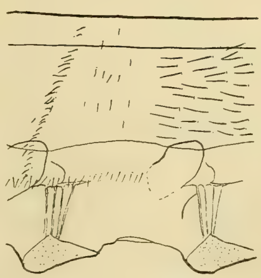


Fig. 43.

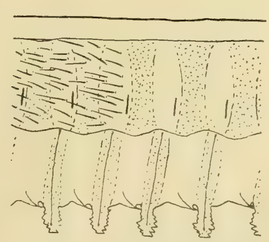


Fig. 44.

that the hind lobes reach, at their tips, above the level of the middle of the scutellum; costa and stigma yellow. .. .. 15.

15. ♀♀. .. .. 16.

—. ♂♂. .. .. 17.

16. Abdomen black or brown with two yellow bands, one covering tergum 2 and the other convexing terga 7, 8 and 9. [Specimens from Victoria are black with yellowish-white labrum, clypeus, cheeks, hind orbits, frontal cushions, hind margin of pronotum, more or less bases of tibiae, tarsi and hind coxae, in addition to the pale bands on the abdomen; specimens from Sydney, New South Wales, show the black giving place to brown, noticeably on the antenna, head, mesonotum, mesopleura and underside of abdomen; in specimens from Queensland this has gone still further, the black being largely replaced by reddish-brown and on the underthorax the yellow of the upper part of the mesopleura is separated by a white band from the brown lower part; saw (Morice, plate xv., fig. 3). The larva of this species was described by Froggatt, 1890, p. 287, as *Perga latreillei* Leach, on *Eucalyptus corymbosa*.] Queensland to Victoria, ♀. .. .. *spinolae* Westwood, 1880.

—. Abdomen usually yellow or brown; it may be partly or entirely black but is not decisively banded with yellow as above. [A very variable species both in colour and form; it may prove later to be a complex of several species; saw (fig. 44 and Morice, plate xv., fig. 2); scutellum, fig. 18.] Queensland to South Australia, ♀. .. .. *latreillii* Leach, 1817, ... (= *dalmanni* Westwood, 1880, and ? *titschacki* Forsius, 1929).

17. Four or five basal terga of abdomen, each yellow in the middle but banded on the front and hind margins with dark brown; forewing with a dark scaly patch under the stigma occupying the two first cubital cells and the basal half of the radial cell. Queensland to Victoria, ♀. .. .. *spinolae* Westwood, 1880.

—. Abdomen not so banded; forewing without a dark scaly patch under the stigma. Queensland to South Australia, ♂. .. .. *latreillei* Westwood, 1880.

PERGAGRAPTA CONDEI, *sp. nov.*

♀. Colour chestnut with the following parts yellowish white; labrum, clypeus, antennal crests, antenna, inner and outer orbits, vertical furrows, pronotum, the unpunctured hind portion of the middle lobe of the mesonotum, the lateral surface of the mesonotum, the scutellum (except the hind margin and lobes), upper two-thirds of mesopleura, the metapleura, legs (except for the apex of the hind femur and the joints of the tarsal segments), a large lateral spot behind the stigma on the side of each tergum (except on the first and last terga).

Wings strongly yellowish infuscate, slightly more hyaline at apex; stigma, costa, venation and upper half of first cubital cell brown.

Length: 25 mm.; forewing, 21 mm.; antenna, 4 mm.

Head above shining with sparse punctures and the whole appears very flat forming a sharp angle behind when viewed from the side; postocellar region is raised above the temples at the sides but is not clearly defined at the sides; it is about as long as broad, broadening slightly behind and with a conspicuous longitudinal medial furrow.

Thorax with pronotum, front lobe of mesonotum (except hind portion) and upper 2/3rds of mesopleurae densely punctured and dull; side lobes of mesonotum and scutellum shining with very sparse vague punctures; scutellum broader than long, with well-developed lobes, and longitudinally divided by a very deep furrow, deepening and broadening behind; hind basitarsus about as long as the rest of the tarsal segments together.

Wings with 3rd transverse cubital vein in forewing angled and oblique so that it is directed towards a point basal to the apex of the stigma at a distance of at least a quarter the length of the stigma.

Abdomen normal with saw not distinguished from that of *P. polita* Leach (Morice, plate xiv., fig. 9).

South Australia, Adelaide, 1 ♀ (holotype) (British Museum 1919-64), "collected for me by a schoolboy", R. C. L. Perkins.

Pergagrapta turneri, *sp. nov.*

♀. Colour chestnut with the following parts yellowish white; labrum, clypeus, antennal crests, antennae, inner and outer orbits, vertical furrows, posterior half of pronotum, unpunctured hind portion of the middle lobe of the mesonotum, a mark on the lateral surface of the mesonotum, the front 2/3rds of scutellum, upper 2/3rds of mesopleurae, trochanters, tibiae (except on the hind legs, the apical quarter) and tarsi of legs, a small lateral spot behind the stigma on the side of each tergum.

Wings with a slightly yellowish infuscation just under the stigma of the forewing in the radial and first three cubital cells; stigma, costa, venation and upper half of first cubital cell brown.

Length: 19 mm.; forewing, 18 mm.; antenna, 2.5 mm.

Head above shining between the punctures which are dense in the neighbourhood of the vertical furrows; POL slightly less than OOL (about 11:12); postocellar region raised above the temples each side and is about as long as broad, broadening slightly behind and with a conspicuous longitudinal medial furrow.

Thorax with pronotum, front lobe of mesonotum (except hind portion) and upper 2/3rds of mesopleura densely punctured and dull; scutellum and side lobes of mesonotum with sparse vague punctures except in the middle, immediately in front of the scutellum, where the puncturation is dense and the surface dull; scutellum broader than long with well-developed lobes and longitudinally divided by a very deep furrow, deepening and broadening behind; hind basitarsus longer than the three following but not so long as all the following trasal segments together.

Wings with the third transverse cubital vein in forewing angled and oblique so that it is directed towards a point basal to the apex of the stigma at a distance of at least a quarter the length of the stigma.

Abdomen normal with saw not distinguished from that of *P. polita* Leach; ♂ as in ♀, but has a scaly patch in the middle of the radial cell on the underside of the forewing.

Length: 12.5 mm.; forewing, 11 mm.; antennae missing.

Queensland: Mackay, 1 ♀ (holotype), G. Turner (British Museum, 1892—16); 1 ♀, ii., 1892 and 2 ♀♀, xi., 1892, R. E. Turner; Cairns, 1 ♂ (allotype), R. E. Turner (B.M., 1910—225).

PERGAGRAPTA HACKERI, *sp. nov.*

♀. Colour as in *P. turneri,* sp. nov., except that the pronotum is much paler, the chestnut being limited to the middle front portion, the hind tibiae are not brown on their apical quarter, at the most being slightly discoloured only at the extreme apex, while the forewing is slightly yellowish hyaline throughout (not only under the stigma).

Length: 19-22 mm.; forewing, 17-18 mm.; antenna, 3 mm.

Head as in *P. turneri,* sp. nov., but that the postocellar region is actually slightly broader than long.

Thorax and abdomen as in *P. turneri,* sp. nov.

♂ as in ♀, but has a scaly patch on the underside of the forewing beneath the stigma as in *P. turneri,* sp. nov.

Length: 16-20 mm.; forewing, 14-17 mm.; antenna, 3 mm.

Victoria: 1 ♀ (holotype), Melbourne, R. E. Turner (British Museum, 1915—86); 1 ♀, ix., 1901, R. E. Turner (B.M., 1909—123); 1 ♀ (B.M., 1850—7); 1 ♂ (allotype) (B.M., 1858—73); 1 ♂, 1 ♀, near Melbourne; 1 ♀, Noble Park, C. Oke; 1 ♂, Nairnsdale, G. Easton, iii., 1925, Dr. Sweet; and 1 ♀ without date. (These five in the National Museum, Melbourne.)

PERGAGRAPTA MALAISEI, *sp. nov.*

♀. Colour reddish-brown except for the following parts which are fusions; tips of mandibles, furrows behind the clypeus and surrounding the frontal area, front of anterior mesonotal lobe, a vitta on each of the side lobes, apices of femora, most of the hind tibia and basitarsus, middles of the dorsum of the abdomen on terga 3-8.

Wings hyaline, with only apical half of forewing tinged with brown; costa, subcosta, basal and median veins mostly blackish brown; stigma and rest of venation brown.

Length: 12-14 mm.; forewing, 10-12 mm.; antenna, 2 mm.

Head, face and outer orbits unpunctured, but upper surface of head densely punctured; postocellar area clearly defined at sides and raised above the temples each side, broader than long in proportion of about 15:12; glabrous and with shining interspaces in the raised middle part, densely pubescent on the sides and depressed parts of temples near vertical furrow.

Thorax: Pubescence very short and sparse on mesopleura and on side lobes of mesonotum limited to the depressed medial parts; dense on the front lobe and scutellum; front lobe of mesonotum shining with irregularly placed punctures in the middle; more densely punctured at the sides; side lobes shining with scattered punctures becoming more dense medially behind; scutellum with shining interspaces between punctures, flat above with no clear longitudinal medial furrow, but with the hind lobes well-developed and extending backwards far beyond the middle of the hind margin of the scutellum; basitarsus of hind legs equal to about the three following tarsal segments together; wings with third transverse cubital vein of forewings not sharply angled, but slightly oblique only and directed towards the extreme apex of the stigma. Abdomen with pubescence very sparse and mostly on apical and basal terga only; usual transverse wrinkles to the terga are almost obsolete; saw as in *Perga glabra* W. F. Kirby (Morice, 1919, plate 15, fig. 4).

Victoria: 1 ♀ (holotype), Windsor, 21, xii., 1909, G. F. Hill (National Museum, Victoria), 1 ♀, Gippland (British Museum).

PERGAGRAPTA NIGRA, *sp. nov.*

(= *Perga bella* var. *nigra* Rohwer, in Morice, 1919, p. 278, footnote.)

♀. Colour black with the following parts creamy white; hind margin of clypeus, inner and outer orbits, patch in the hollows each side of the post-ocellar area, flagellum of antenna, hind margin of pronotum, hind unpunctured portion of front mesonotal lobe, stripe on the upper margin of the lateral surface of the middle lobes and the lateral ridge, triangular patch on scutellum (the hind margin and lobes of the scutellum forewing the base of the triangle, the apex reaching the front margin) a transverse band across the mesopleurae, the upper margin of the mesonotum, trochanters bases of tibiae and tarsi, and a patch on each tergum occupying most of the central part of the portion that is bent over on to the ventral side; the following parts are yellow: the mandibles (except their tips), the labrum, part of the cheek behind the pale outer orbits, margins of pale vertical spots, femora (except black extreme apex of hind pair) and apices of tibiae.

Wings slightly yellowish hyaline throughout; stigma costa and venation yellow.

Length: 15 mm.; forewing, 14 mm.; antenna, 2.5 mm.

Puncturation very dense and close without interspaces on upper part of head, pronotum and mesonotum (except the small pale hind portion of the front lobes and the lateral surfaces of the hind lobes) including the scutellum; mesopleura likewise very densely punctured above but less densely so at extreme margins and with large shining interspaces on lower third; abdomen with dense transverse wrinkles above, but these become obsolete below ♀.

Pubescence well-developed on the heavily punctured areas of the head and thorax; very sparse elsewhere.

Head with POL:OOL in the proportion of about 9:10 with vertical furrows almost obsolete; postocellar area V-shaped, being narrowed behind on a level with the temples each side behind and in front very little raised above them.

Legs with the hind tarsi together about 2/3rds length of the hind tibia.

Thorax: Scutellum slightly convex with a medial transverse depression; hind lobes well-developed extending back further than the middle of the hind margin.

Wings with third transverse cubital vein in forewings slightly oblique, not angled, and directed towards a point almost at the apex of the stigma; cubital cell in hindwings very little shorter than the free apical end of the cubital vein.

Saw as in *bella* group (Morice, 1919, plate xv., fig. 5).

New South Wales: Cumberland, 1 ♀, R. E. Turner, British Museum, 1909 —220, "*Perga bella* var. *nigra*, type Rohwer", MSS. label.

PERGAGRAPTA ROSSI, *sp. nov.*

♀. Colour yellowish-brown with the following parts black: apex of mandibles, front of side lobes of mesonotum, lower ¼ of mesopleura, meso-

sternum and more or less terga 2 to 6 medially and sterna of abdomen; creamy-white are the following: spot each side of clypeus, inner orbits between clypeus and eye, outer orbits, antennal crests, a patch each side of the postocellar area, hind margin of pronotum, tegulae, hind angle of front mesonotal lobe, stripe on lateral surface of side mesonotal lobes, front margin and transverse band across middle of mesopleura, metapleura, patch on the lateral portion of each of the terga 2-8.

Wings yellowish hyaline; subcosta, median and basal veins black; stigma costa and rest of venation yellow.

Length: 12 mm.; forewing, 10 mm.; antennae missing.

Head with POL:OOL in proportion of about 3:4; very shining above on the temples and postocellar region with sparse scattered punctures; whole surface flat and slightly rounded without any definite raised postocellar area and without definite vertical furrows, which are indicated mostly by slightly denser puncturation.

Thorax dull with dense close punctures on pronotum; mesonotum with shining interspaces especially on hind angle of front lobe, raised parts and lateral surfaces of side lobes and scutellum; mesopleura with coarse dense punctures in the middle of the upper portion; round the margins and on the lower 1/3rd the punctures are scattered with large shining interspaces; scutellum broader than long, convex with a medial longitudinal depression, and well developed hind lobes.

Legs with hind tarsi about 2/3rds length of hind tibia.

Wings with third transverse cubital vein in forewing slightly oblique, not angled ,and directed towards a point almost at the apex of the stigma; cubital cell in hindwing about 1/3rd shorter than the free apical end of the cubital vein.

Abdomen with the usual strong transverse wrinkles on the dorsum.

Saw as in *bella* group (Morice, 1919, plate xv., fig. 5).

Victoria: Windsor, 1♀, xii., 1909, B. F. Hill (National Museum, Victoria).

Pergagrapta rohweri, *sp. nov.*

♀. Colour yellowish-brown with the following parts creamy-white: a spot each side of clypeus, inner orbits between antenna and eye, outer orbits, antennal crests, flagellum of antenna, spot each side of postocellar area behind, hind margin of pronotum, hind angle of front lobe of mesonotum, ridge on lateral surface of side lobes of mesonotum, middle of scutellum, upper 2/3rds of mesopleura (except for a patch occupying the middle and spreading to the upper margin), upper margin of mesosternum, metapleura, trochanters and on the abdomen a patch on the ventral portion of each of the terga 2-8; in the holotype the black is confined to the extreme apices of mandibles, the lower 1/4th of mesopleura with mesosternum the base of the hind coxae and the middle of terga 2-4; in the paratype the black is much more extensive, the following being also black: the front margin of the pronotum with the prosternum, a vitta on each of the side mesonotal lobes, the epimeron of the mesopleurae, and the first 7 segments of the abdomen except for the above-mentioned creamy white patches on the ventral portions of the sterna.

Wings yellowish hyaline; subcosta, median and lateral veins black; stigma, costa and rest of venation yellow.

Length (holotype), 15 mm.; forewing, 14 mm.; antenna, 2 mm. (paratype), 20 mm.; forewing, 18 mm.; antennae missing.

Head above very flat, the postocellar area behind being almost on the same level as the temples each side while in front where the area becomes much broader it is slightly convex; behind it is ill-defined, the vertical furrows which are clearly depressed in front being obsolete behind and deplaced by a small shining unpunctured pale patch.

Thorax with mesonotum heavily punctured, though on the side lobes and scutellum there are considerable shining interspaces; mesopleura on the upper 3/4ths with large regular punctures separated by finally sculptured interspaces; lower 1/4th with denser finer punctures; scutellum roundly convex without apparent medial transverse furrow so that the tops of the hind lobes, though well developed are yet below the level of the middle of the scutellum when viewed from the side.

Legs with hind tarsi equal to about 2/3rds length of hind tibia.

Wings with third transverse cubital vein of forewing slightly oblique, not angled, and directed almost towards the apex of the stigma; hindwing with cubital cell about equal in length to the free apical end of the cubital vein.

Abdomen with normal transverse wrinkles on dorsal surface and saw as in *bella* group (Morice, 1919, plate xv., fig. 5).

South Australia: Adelaide, 1 ♀ (holotype) (British Museum, 1853—8); 1 ♀ (paratype) (National Museum, Victoria).

Paraperga Ashmead, 1898.

Head when viewed from above, swollen behind the eyes but shorter behind the eyes than the length of an eye; palps as in *Perga*; clypeus flat and slightly emarginate in front; malar space slightly longer than pedicel of antenna; antenna 6-segmented, clavate, much shorter than breadth of head, but longer than clypeus; funiculum clearly longer than broad; segment 4 about twice as long as broad; frontal crests prominent but small, being much wider apart than the distance between them; POL less than OOL; postocellar area clearly defined by deep straight grooves each side but viewed from behind appears no higher than the swollen temples each side of the grooves.

Thorax with scutellum (fig. 13) narrowed behind so that it is about as wide behind as the medial length; the front portion that projects in front of the front angles is cut off by a deep transverse groove parallel to the hind margin and joining the two front angles; front and hinder portions being convex; medially there is a small groove bisecting the scutellum in half longitudinally; hind lobes large and projecting backwards clearly further than the middle of the hind margin does.

Wings with a short broad stigma about two-thirds as broad as the radial cell and only about half as long; 3rd cubital cross-vein only slightly curved and directed almost to the apex of the stigma; 4th cubital cell not quite 7/8ths as long as rest of cubital cells together; basal and 1st recurrent veins curved and subparallel, and both received in 2nd cubital cell (always?).

Legs with fore-tibia bearing a few incrassate hairs on the inside towards the apex; hind basitarsus only about one and a half times as long

as the following tarsal segment and less than the two following tarsal segments (segments 2 and 3); apices of hind legs missing.

Abdomen broad and rounded apically, strongly rugulously punctured; sawsheath expanding slightly behind where it is almost trifid, basally clothed with simple hairs; ♂ unknown.

Monotypic: West Australia. Type, *Perga jucunda* W. F. Kirby, 1882.

I have seen only a single ♀, the type of this species. It is a violaceous black insect about 15 mm. long with the temples, scutellum and sides of abdomen bright orange-red.

Antiperga, *genus nov.*

Head when viewed from above, shorter behind the eyes than the length of an eye; clypeus slightly convex with the emarginate from margin inflexed; malar space slightly longer than the distance between the eyes; segment 4 less than twice as long as broad; POL:OOL varying; frontal crests prominent and each may be about as broad as the distance between them; postocellar area raised above the temples and margined laterally with subparallel vertical furrows; upper part of temples densely punctured in contrast with the unpunctured outer orbits.

Thorax with scutellum narrowed behind but yet generally wider behind than is the medial length; surface clearly convex with or without a vague medial groove; hind lobes small and projecting little or not at all beyond the level of the middle of the hind margin.

Wings generally partly brownish or yellowish; radial cell of forewing about twice breadth of stigma; 3rd cubital cross-vein usually curved; 4th cubital cell at least about as long as the rest of the cubital cells together; basal and 1st recurrent veins diverge strongly towards the stigma; ♂ with a special hairy patch under the stigma on the forewing occupying the base of the radial the 1st and 2nd cubital cells and spreading into the 2nd discoidal cell.

Legs with fore-tibia bearing a few incrassate hairs on the inside towards the apex; hind basitarsus scarcely as long as the next two tarsal segments together; tarsi 2/5ths to 4/5ths as long as hind tibia, being longer in ♂♂ than in ♀♀.

Abdomen short and stout, strongly rugulously sculptured above; ♀ sawsheath, viewed from above, expands very slightly behind, where it is truncate and basally it is clothed in simple fine hairs; ♀ saw fig. 40; ♂ abdomen above at least lightly pubescent but not densely so.

W. and S. Western Australia. Type, *Perga antiopa* Morice, 1919.

Key to Antiperga species.

1. ♀♀. . . . . 2.
—. ♂♂. . . . . 4.

2. Antennae about twice as long as distance between their insertions; hind tarsi about 2/5ths as long as hind tibia. . . . . 3.
—. Antennae about $1\frac{1}{2}$ times as long as distance between their insertions; hind tarsi about 3/5ths as long as hind tibia. [Antenna entirely black; stigma brown; wings brownish infuscate apically.] Western Australia, ♀. . . . . *enslini* sp. nov.

3. Stigma and flagellum of antenna black; wings brownish infuscate apically; femora and tibiae pale basally, but marked with black at their apices; mesonotum shining between coarse irregular punctures; POL less than OOL. South Western Australia, ♀. . *antiopa* Morice, 1919.

—. Stigma and flagellum of antenna brown; wings hyaline; femora pale, slightly infuscate basally; tibiae pale with brownish apices; mesonotum dull with dense puncturation; POL greater than OOL. South Western Australia, ♀. . . . . *clarki* sp. nov.

4. Hind tarsi 4/5ths as long as hind tibia; puncturation very dense on head and thorax so that the surface is dull; abdomen brown above and yellow beneath. Western Australia, ♂. . . . . *enslini* sp. nov.

—. Hind tarsi 3/5ths as long as hind tibia; puncturation coarse on head and thorax with shining interspaces; abdomen black above and white beneath. South Western Australia, ♂. . . . . *antiopa* Morice,

ANTIPERGA ENSLINI, *sp. nov.*

♀. Colour white; the following parts black: apices of mandibles, labrum, groove at base of clypeus, median fovea, upper part of head (except for frontal cushions, inner and outer orbits and vertical stripes), pronotum except for hind margin, mesonotum (except for margin of tegulae, outer stripes on side lobes and scutellum), lower 1/4th of mesepisternum, mesepimeron and mesosternum, bases of coxae, bases of front and middle femora and apices of hind tibial and all tarsal segments, dorsal surface of terga 1-6 with sawsheath and its neighbourhood.

Wings brownish, especially at apex of forewing, stigma and base of costa brown, apex of costa, subcosta and rest of venation black.

Length: 11.3 mm.; forewing, 9.5 mm.; antenna, 2 mm.

Puncturation on upper part of head and mesonotum mostly fine and regular but disappearing on the hind orbits and also in the middle of the postocellar region where is a large unpunctured area; mesepleura with irregular punctures and wide shining interspaces; scutellum very vaguely and shallowly punctured; abdomen densely transversely rugulous above; elsewhere insect is without definite punctures.

Head with POL:OOL in proportion of about 13:17; postocellar area a little broader than long, though not very clearly defined, and raised above the temples each side.

Thorax with scutellum small and slightly convex, longer in the middle than broad behind, with hind lobes very small and conical scarcely reaching so far back as the middle of the hind margin, puncturation very sparse and median groove almost obsolete; mesepisternum of mesopleura with scattered irregular punctures.

Wings with third transverse cubital vein of forewing slightly angled so that it is directed towards a point a little basal to the apex of the stigma.

Legs with hind tarsi together equal to about 3/5ths length of hind tibia; hind basitarsus very short, little longer than the following tarsal segment and shorter than the following two segments together.

Abdomen normal, saw not unlike that of *P. antiopa* Morice (fig. 40).

♂. Colour: Yellow with the following parts black: the ocellar region of the head; a spot behind the temples; the two basal antennal segments; the

front of the pronotum; the mesonotum except for a spot each side of the front lobe; the outer sides of the side lobes and the scutellum; metanotum with the first and base of the second terga of the abdomen; rest of abdominal terga 2-7 with the sides and apical half of each segment, flagellum, mesosternum, apices of hind tibia and tarsi brown.

Length: 10 mm.; forewing, 8 mm.; antenna, 2.8 mm.

Otherwise as in ♀ (except for sexual characters) save that the punctuation on the postocellar area is denser and the hind tarsi together are about 4/5ths as long as hind tibia.

Western Australia: Perth, 19 ♀♀ (including holotype), 25.ii. to 12.iii., 1936, 1 ♂ (allotype) and 2 ♀, 16 to 29.iii., 1936, *"on Melaleuca"*, R. F. Turner (B.M., 1936—28).

Mr. Turner tells me that gregarious black larva which he assumed to belong to this species were abundant on *Melaleuca* a few weeks later in the same locality, near Perth, where he had collected the adults.

ANTIPERGA CLARKI, *sp. nov.*

♀. Colour yellow; the following parts black: apices of mandibles, front margin of labrum, furrow at base of clypeus, median fovea, upper part of head (except for the inner orbits, pale band along the vertical furrows joining them, and the outer orbits), and two basal segments of antenna; medial narrow part of pronotum, mesonotum (except the lateral faces and the scutellum) the lower third of the mesopleura with a spot on the mesepimeron, the mesosternum, the metanotum at the sides, and the basal half of the front and middle femora; dorsal portions of terga 1 and 2 at the sides and the furrow between them, dorsal portions of terga 3-6, the terga of 7 and 8, the whole of 9 and apical segments with sawsheath, as well as the apical ½ of sterna 3-6.

Wings hyaline, with stigma, costa and venation brown.

Length: 12 mm.; forewing, 10 mm.; antenna, 2.5 mm.

Puncturation on upper part of head and mesonotum very fine, close and irregular; on pronotum the punctures are shallower with interspaces; scutellum with vague almost obsolete punctures; mesopleurae with dull interspaces between large regular punctures; abdomen above with close transverse striae; rest of insect without regular punctures.

Head with POL:OOL in proportion of about 20:17; postocellar area 5/6ths as long as broad, clearly defined with deep straight vertical furrows, and raised well above the temples each side.

Thorax has scutellum strongly convex, much broader behind than its total length, divided longitudinally by a clearly defined medial furrow, and with the hind lobes very small so that they do not reach so far back as the middle of the hind margin.

Wings with third transverse cubital vein of forewing strongly angled so that it is directed towards a point basal to the apex of the stigma by a distance of about 1/4th the length of the stigma.

Legs with hind tarsi together equal to about 2/5ths the length of hind tibia; basitarsus about as long as the two following tarsal segments together.

Abdomen normal, saw not distinguished from that of *P. antiopa* Morice (fig. 40).

West Australia: Perth, 1 ♀, J. Clark (Queensland Museum, Brisbane).

Pseudoperga Guérin, 1845.

Redescription: Length of head behind the eyes when viewed from above is as great or greater than the length of the eye from the same viewpoint (fig. 24); frontal crests small; palps as in *Perga*.

Head sub-parallel sided or swollen behind the eyes; clypeus flat; malar space twice length of pedicel and longer than diameter of front ocellus; antenna clavate, 6-segmented and less in length than the distance between the eyes; segment 4 not more than twice as long as broad; funicle about as broad as long; postocellar area subparallel sided and clearly defined OOL greater than or equal to POL in ♀; less than POL in ♂.

Thorax: Scutellum broader behind than long, flat or even slightly concave in the middle and sparsely punctured, but in *P. ferruginea* Leach, slightly convex with a vague medial furrow and heavily punctured; hind lobes normally very short and not projecting so far back as the middle of the hind margin of the scutellum, but sometimes (in *P. ferruginea*) they extend further back than the middle of the hind margin.

Wings with a very large stigma about as broad in forewing as the greatest breadth of the radial cell (fig. 10); 3rd cubital cross-vein of forewing strongly bent and directed towards a point on the stigma about a third from the apex; 4th cubital cell longer than the rest of the cubital cells together; basal and 1st recurrent veins converge slightly towards the stigma; males without definite hairy patches in the wings.

Legs with fore-tibia bearing a few incrassate hairs on the inside towards the apex; hind basitarsus longer than two following tarsal segments together; hind tarsal segments together at least two-thirds as long as hind tibia.

Abdomen in female tapering and acuminate apically; the narrow 9th tergum projects beyond the sawsheath; sawsheath clothed with simple hairs; ♀ saw as in fig. 11; ♂ abdomen slightly pubescent above.

In this genus occur the extraordinarily developed social habits of larvae and maternal care of them by their parents (see Lewis, 1837 and 1865).

Queensland, N.S.W., Victoria, S. and W. Australia. Type, *Perga lewisii* Westwood.

Key to Pseudoperga species.

1. Claw-bearing hind tarsal segment measured along upper side, longer than segments 3 and 4 together; hind tarsi together only about 2/3rds to 3/4ths as long as hind tibia. 2.

—. Claw-bearing hind tarsal segment less than segments 3 and 4 together; hind tarsi together from 7/8ths to about the same length as the hind tibia. . . . . 4.

2. Mesopleura with regular widely-spaced round punctures; POL about equal to OOL in ♀. . . . . 3.

—. Head mesonotum and upper 3/4ths of mesopleura dull and rugged with coarse irregular puncturation; POL less than OOL. [Yellowish brown species; apices of hind femur, tibia and tarsi dark brown; wings yellowish; ♂ with upper part of head (except vertical area), vittae on mesonotal lobes and narrow bands on abdomen black.] Western and South Australia, ♀ and ♂. . . . . *rugiceps* Forsius (1927).

3. Antenna very short, so that the flagellum is less than the length of the front margin of the clypeus; head and mesonotum very shining with only sparse punctures. [Reddish-brown species often with stripe behind eye, vittae on mesonotal lobes, apices of hind femur and hind tibiae with whole of hind tarsi black; ♂ unknown.] ? New South Wales and Western Australia, ♂ and ♀. . . . . *lucida* Rohwer (1910).

—. Antenna longer, so that the flagellum is greater than the length of the front margin of the clypeus; head and mesonotum shining between coarse punctures (notably the temples each side of the postocellar region and the sides of the front lobe of the mesonotum are densely punctured). [Head above, with antenna, mesonotum, legs and abdomen above deep brown; scutellum, under-thorax and abdomen beneath yellow; ♂ unknown.] Western Australia, ♀. . . . . *moricei* Forsius (1927).

4. Antenna very short so that it is no longer than the front margin of the clypeus and the flagellum is less in length than the distance between the insertions of the antennae. . . . . 5.

—. Antenna longer than front margin of clypeus and flagellum much longer than the distance between the insertions of the antennae. . . . . 6.

5. Scutellum convex and generally densely punctured; its hind margin depressed; the hind lobes well-developed and extending backwards further than the middle of the hind margin; ♀ deep chestnut colour all over, darker on the head, mesonotum, hind femur and hind tibia with deeply brownish wings; ♂ has head above and mesonotum black with under parts usually yellowish brown; hind basitarsus shorter than next two tarsal segments together. Saw (Morice, plate xiv., fig. 14). Queensland to Victoria, ♂ and ♀. . . . . *ferruginea* Leach (1817). (= *scabra* Newman, 1846, *newmanni* Westwood, 1880, *sellata* W. F. Kirby, 1882, and *froggatti* Rohwer, 1910.)

—. Scutellum flat or slightly concave, with only vague coarse punctures; hind margin raised above the level of the middle and extending backwards further than the apices of the hind lobes; ♀ brownish yellow with at least apical 1/3rd of hind tibia and most of tarsi, and sometimes a stripe behind each eye and a vitta on the mesonotal lobes black; ♂ has upper parts of head, mesonotum band on mesoepisternum and mesosternum black, but dorsum of abdomen steel blue; hind basitarsus longer than next two tarsal segments together. [Antenna black.] New South Wales, Victoria and South Australia, ♂ and ♀. *belinda* W. F. Kirby (1882) (= *nemoralis* Wilson, 1932, and ? *corrugata* . . . . Forsius, 1935).

6. Antenna mostly black; mesopleura with few scattered punctures and shining areas between the punctures; upper part of head with a few shining interspaces among the punctures. [According to Wilson (1932, p. 46) this species is common in East Victoria and is frequently seen guarding its eggs and young, while the following species is rare. Saw (fig. 41 and Morice, plate xiv., fig. 15).] Queensland to South Australia, ♂ and ♀. . . *guerinii* (Westwood, 1880) (= *smithii* Westwood, 1880).

—. Antenna always pale; mesopleurae at least in the middle densely regularly punctured; upper part of head without any shining interspaces among the punctures. ♂ and ♀. Queensland to South Australia. [The larva of this species feeds on *Eucalyptus corymbosa* and was described

by Froggatt, 1890, p. 286. For accounts of the maternal instinct in this species, see Lewis (1836, 1865) and Blackburn (1930). Saw (Morice, plate xiv., fig. 13).] Queensland to South Australia, ♂ and ♀. . . . . *lewisii* Westwood (1836).

ACANTHOPERGA Shipp, 1894.

Redescription: ♀. Head and palps as in *Perga* but the eyes are much more rounded (fig. 25); the antenna (fig. 3) is longer than the breadth of the head, 6-segmented, with funicle more than 1½ times as long as broad, segments 3, 4 and 5 almost equally long and each more than 4 times longer than broad; POL much less than OOL; clypeus with a slightly inflexed and emarginate apex; postocellar area slightly raised and with subparallel vertical furrows.

Thorax: Scutellum (fig. 14) about as long as the breadth behind, almost flat with at most a slight medial groove; hind lobes well developed and reaching back further than does the middle of the hind margin of the scutellum.

Wings with a small stigma not much more than ½ the breadth or length of the radial cell in the forewing; 3rd cubital vein almost straight and directed to a point behind the apex of the stigma; 4th cubital cell only about 2/3rds as long as the rest of the cubital cells together.

Legs with the fore tibia bearing a few incrassate hairs on the inside towards the apex; hind basitarsus as long or longer than the 3 following tarsal segments together; hind tarsi together not greater than about 2/3rds the length of the hind tibia; 5th hind arsal segment about as great as 3 and 4.

Abdomen stout with the dorsum dull with dense transverse rugulous sculpture; saw as in Morice, plate xiv., fig. 18. Type, *Perga cameronii* Westwood.

Key to ACANTHOPERGA species.

1. Postocellar area longer than broad and very densely and finely punctured without shining interspaces; tips of forewings infuscate; abdomen orange brown above. . . . . 2.

—. Postocellar area broader than long and with shining interspaces between the punctures; forewings not tipped with fuscous; abdomen yellow above. [Antenna (fig. 3) with apical segment shorter than 4 and 5; pedicel about as long as broad and as long as the malar space; hind basitarsus equal in length to the 3 following segments; pubescence on head and mesonotum piceous.] N. Queensland, ♀. . . . . *leucomelas* Rohwer, 1910.

2. Pedicel of antenna about as long as broad and as long as the malar space; hind basitarsus nearly equal to rest of tarsal segments together (about 7/8ths as long); pubescence on head and mesonotum piceous. [Apical segment of antenna longer than 4 and 5.] New South Wales, ♀. . . . . *marlatti* sp. nov.

—. Pedicel about twice as broad as long and about ½ as long as malar space; hind basitarsus only about 3/4rds as long as rest of tarsal segments together; pubescence on head and thorax brown. [Antenna not seen; saw Morice, plate xiv., fig. 18.] Queensland and New South Wales, ♀. . . . . *cameronii* Westwood, 1870.

ACANTHOPERGA MARLATTI, *sp. nov.*

♀. Colour: Brown is the upperside of the head, and mesonotum; orange brown the dorsum of abdomen; chocolate is a spot on the upper hind orbits, the antenna except the apical 2/3rds of the last segment, a band starting on the pronotum, crossing the upper ½ of the pleura, and continuing along the lateral upper edge of the terga and covering the whole of the upper side of the last 2 terga, also the outer side and apex of tibia and more or less the 2 basal tarsal segments of the front and middle legs, the whole of the tibia and basal 2/3rds of the basitarsus of the hind legs; yellowish-white is the lower part of the head and face, the apical 1/3rd of the last antennal segment, the underside of thorax including femora, base of tibia in fore and middle legs, the apical tarsal segments and the underside of the abdomen; pure white is a band crossing the pleura immediately below the chocolate colour and continuing along the downturned sides of the terga but merging below into the yellowish white.

Wings slightly yellowish-tinged, with the extreme apex of the forewing fuscous; this band extending over the apical ½ of the 4th cubital cell; stigma and venation brown.

Length: 13 mm.; forewing, 11 mm.; antenna, 5 mm.

Head densely and finely punctured above, without interspaces on the postocellar area; puncturation becoming finer laterally so that on the hind orbits and face are no punctures; pubescence very short and piceous; antenna with the apical segment as long as segments 5 and 4 and half of 3 pedicel (2nd segment) nearly twice as long as broad and equal in length to the malar space.

Thorax with mesonotum dull, densely and finely punctured with no shining interspaces; pronotum shining with transverse striae; pleura and sterna shining with scattered punctures on the front ½ of the mesepisternum; hind basitarsus about 7/8ths as long as the rest of the tarsal segments together.

Abdomen dull above with dense transverse regulous sculpture; shining and unpunctured below.

New South Wales: E. Dorrigo, Brooklands, 1♀, 1929, W. Heron (Australian Museum, Sydney).

References:

ASHMEAD, W. H., 1898. "Classification of the Horntails and Sawflies . . 4." Canad. Ent., 30, 231-232.

BENNETT, G., and SCOTT, A. W., 1859. Description of a species of *Perga*, or sawfly, found feeding upon *Eucalyptus citriodora* of Hooker, or Wide Bay Lemon-scented Gum-tree. Proc. Zool. Soc. London, 27, 209-212.

BENSON, R. B., 1935. New Australian Sawflies. Mem. Qld. Mus., Brisbane, 10 (5), 211-229, figs. 1-9.

————. 1938. On the Classification of Sawflies. Trans. Roy. Ent. Soc. London.

EVANS, J. W., 1934. Notes on the behaviour of the larval communities of *Perga dorsalis* Leach. Trans. Roy. Ent. Soc. Lond, 82 (2), 455-460, figs. 1-5.

FORSIUS, R., 1927. On some sawflies from the Australian Region. Rec. Austr. Mus. Sydney, 3 (3), 283-308.

————. 1929 (1). Notes on some little known Australian Tenthredinoidea. Notul. ent. Helsingfers, 9, 81-84.

————. 1929 (2). *Perga titschacki,* eine neue australische Tenthredinoide. Ibid., 9, 85-86.

————. 1935. Drei neue *Perga* Arten. Ibid., 15, 11-15.

FROGGATT, W. W., 1890. Notes on the life-history of certain Sawflies (Genus *Perga*) with description of a new species. Proc. Linn. Soc. N.S.W., 5, 283-288.

————. 1918. Notes on Australian Sawflies. Proc. Linn. Soc. N.S.W., 43, 668-672.

GUERIN, F. E., 1845. Iconographic Règn. Anim., 7, 398.

KIRBY, W. F., 1882. "List of Hymenoptera . . . in the British Museum,", 1, 18-31; plate i., figs. 6 and 11-14; plate ii., figs. 1-15.

————. 1893. "Descriptions of Five new Species of Australian Sawflies." Ann. Mag. Nat. Hist. (6), 12, 38-43.

KONOW, F. W., 1905. "Drei neue Syzygoniides aus Australien." Z. Hym. Dipt., 5, 166-169.

LEACH, W. E., 1817. The Zoological Miscellany, London, 3, 115-119.

LEWIS, R. H., 1837. Case of Maternal Attendance on the Larva by an Insect of the Tribe of Terebrantia, belonging to the Genus *Perga,* observed at Hobarton, Tasmania. Trans. Ent. Soc. London, 1 (3), 232-234.

MORICE, F. D., 1919. Notes on Australian Sawflies, with Diagnostic Synopses of the Genera and Species. Trans. Ent. Soc. London, 1918, 247-333, pls. xiv. and xv.

NEWMAN, E., 1841. Entomologist. 1, 89-90.

RAFF, J. W., 1930. Observations on the Life-history of Sawflies. Vict. Nat. Melbourne, 46, 215-217.

————. 1935. Observations on Sawflies of the Genus *Perga,* with notes on some reared primary parasites of the families *Trigonalidae, Ichneumonidae* and *Tachinidae*. Proc. Roy. Soc. Vict., 47 (New Series), 54-77, pl. iv. and v.

ROSS, J. A., 1929. Social Sawfly Larvae. Vict. Nat. Melbourne, 46, 21.

ROHWER, S. A., 1910. "Some Australian Sawflies." Ent. News Philad., 21, 467-469.

SHIPP, J. W., 1894. "A New Classification of the Genus Perga." Entomologist, 27, 338-340.

WESTWOOD, J. O., 1836. Trans. Ent. Soc. London, 1, 234.

————. 1880. A Monograph of the Sawflies composing the Australian Genus *Perga* Leach. Proc. Zool. Soc. London, 1880, 359-379, plates xxxiii. and xxxvii.

WILSON, F. E., 1932. A new Victorian Sawfly. Vict. Nat. Melbourne, 49, 43-46, figs. ——.

PROFESSOR STRAND'S FESTSCHRIFT.

Festschrift zum 60. *Geburtstage von Professor Dr. Embrik Strand.* (Riga, Latvia), 5 Vols., 1936-39. Price per vol., 30 Lats. (A Lat is 1/4 in Australian or one shilling in English currency). Obtainable from Professor E. Strand, Sist. Zoolog. Inst., Pasta kastite 802, Riga or Mr. H. E. Knowles, 92, Solon Road, London, S.W.2, England.

In Europe, when a scientist reaches the age of 60 or 70, it is the custom of his colleagues to pay tributes to him and his work and a volume of papers (*Festschrift*), embodying the latest researches of the honoured one's friends, is issued. Professor Embrik Strand, of Riga, who reached the age of 60 in 1936, has broken records, since his *Festschrift* has run into five volumes, of which the first four have been sent for review. These contain altogether 2,688 pages, 87 plates, 5 plates in the text and 613 other text-figures. In the first four volumes are 166 zoological papers by 123 authors from all parts of the world, the contributions being in English, French, German, Italian or Latin. A fifth volume, not yet to hand, will include a complete index to all, but each volume has a separate list of contents and can be bought separately.

As editor of the *Archiv. für Naturgeschichte,* Professor Strand has interested himself in a wide variety of zoological subjects, which explains why so many eminent workers, of whom, unfortunately we hear little in Australia, have contributed. All the volumes are indispensable to any zoological or palaeontological library. Some Australian insects are described as new and there are several important articles on birds, fishes and mollusca of Australian or Pacific interest.

It is a "consummation devoutly to be wished" that these volumes may become well known, generally read, considered and made use of by working zoologists, not only in consideration of the many noteworthy contributors, but also in the interests of science itself, to which the *Festschrift* is an important contribution.

—G. P. WHITLEY.

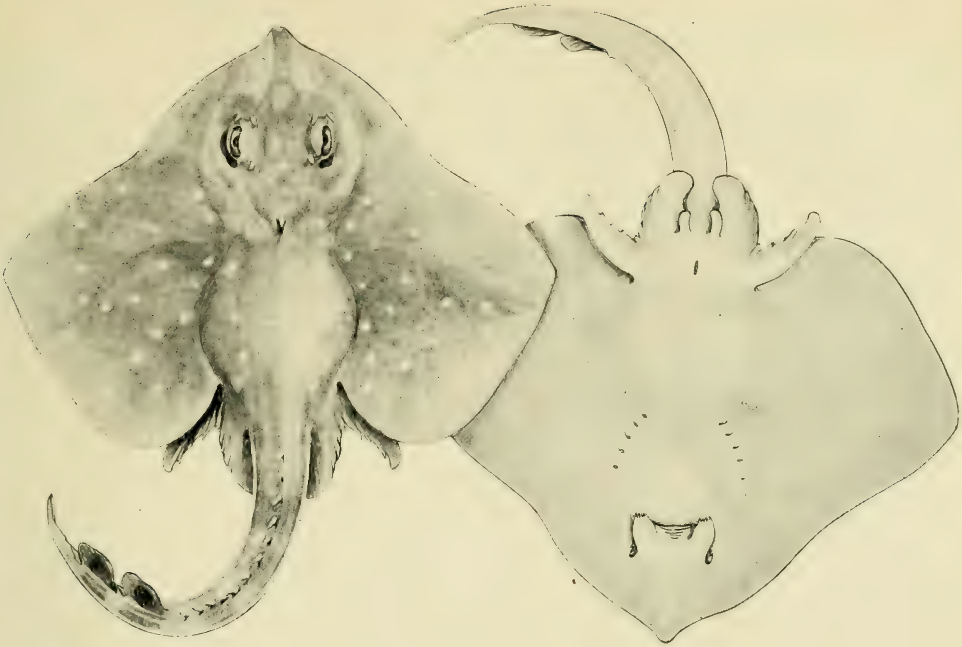


Fig. 1. *Raja cerva* Whitley. Holotype from Bass Strait. (Austr. Mus., Regd. No. E.4970.) . . . . Mary Soady *del.*

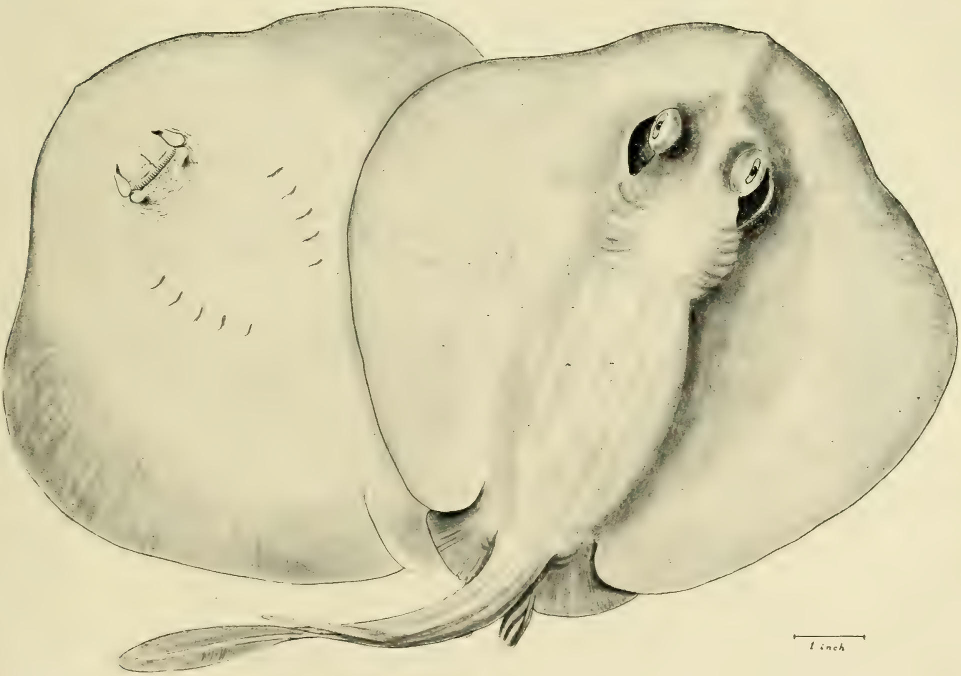
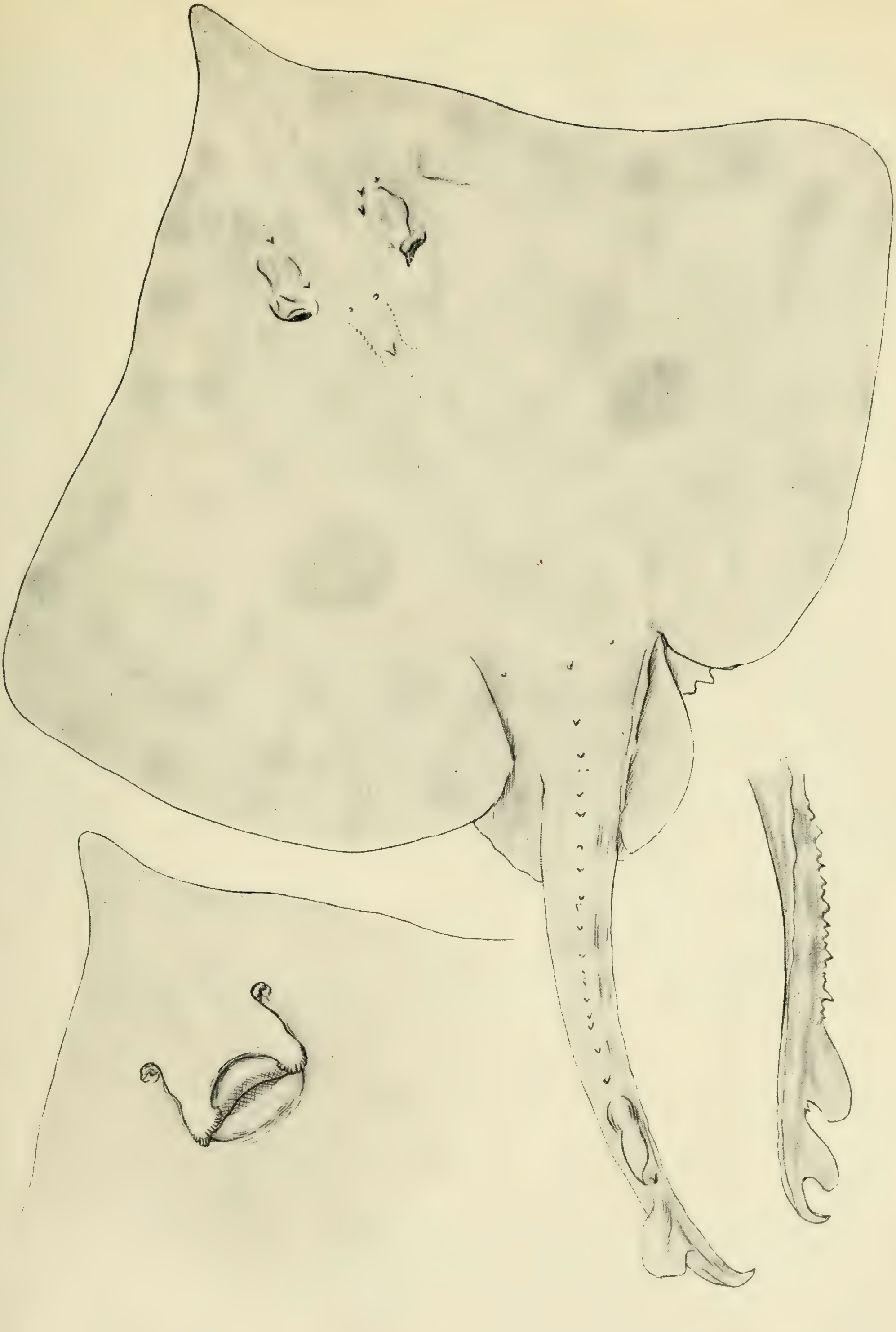


Fig. 2. *Urolophus (Trygonoptera) mucosus* Whitley. Holotype from Albany, Western Australia. (Austr. Mus., Regd. No. IA.670.) . . . . Joyce Allan & G. P. Whitley *del.*



Zearaja nasuta (Müller & Henle). A young specimen from the Portobello Marine Hatchery, New Zealand. (Austr. Mus., Regd. No. IA.7087.) . . . . Joyce Allan *del.*

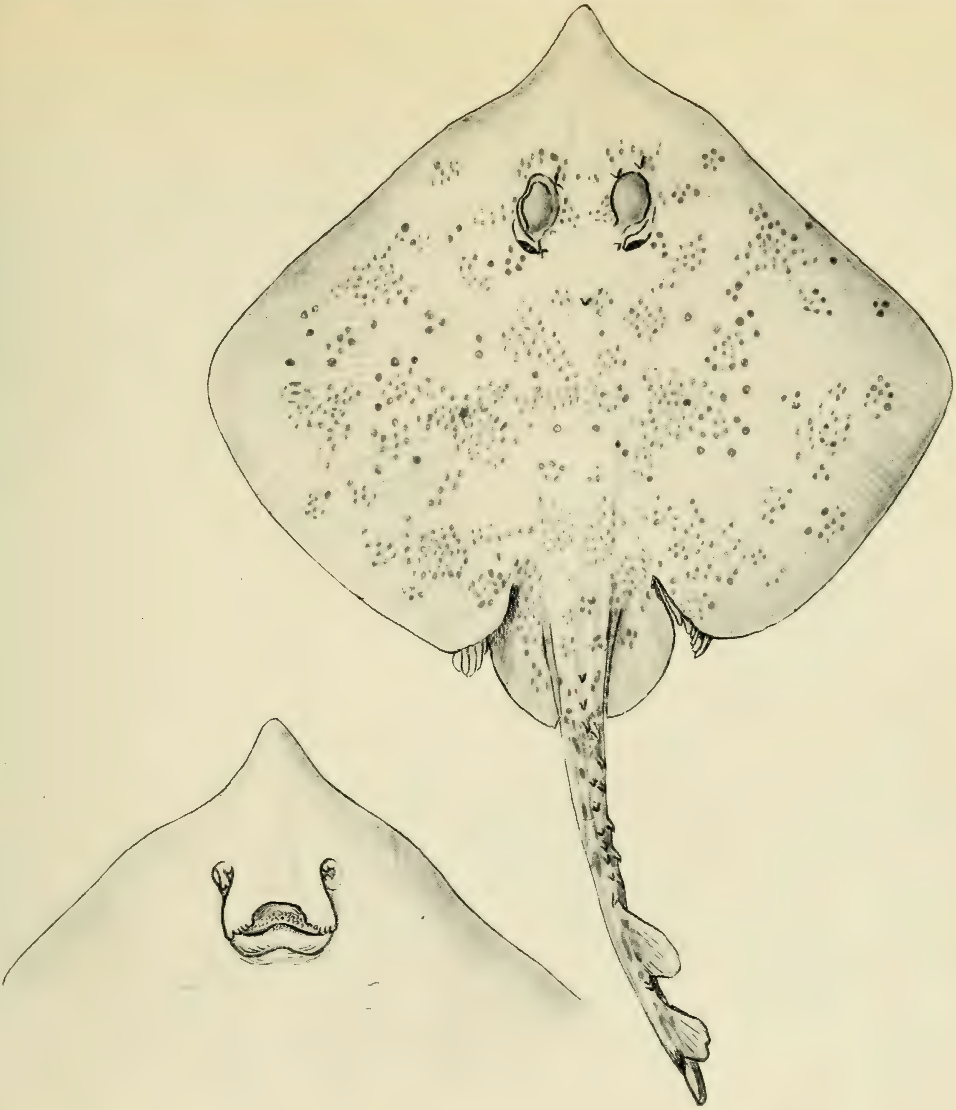


Fig. 1. *Pavoraja polyommata* (Ogilby). Lectotype from off North Reef, Queensland. (Austr. Mus., Regd. No.I.10904.) .. .. Joyce Allan *del.*

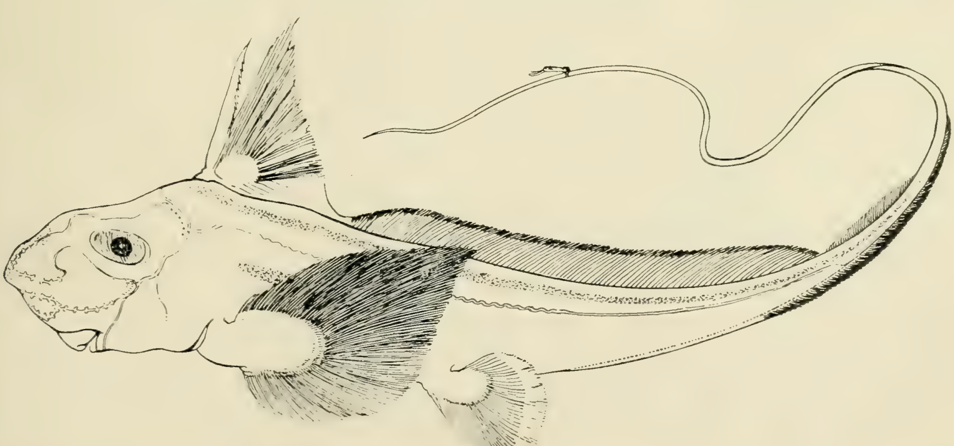
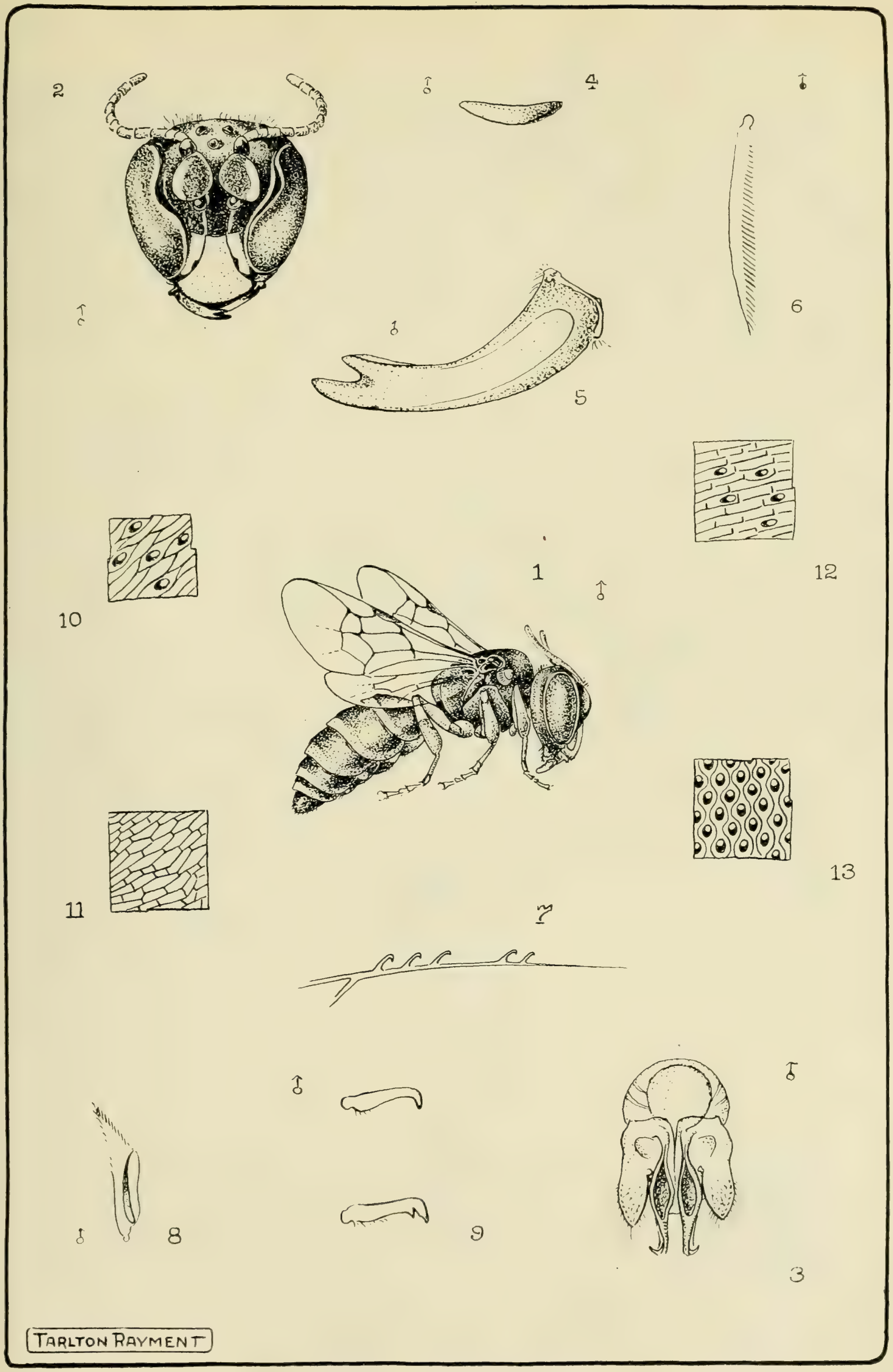
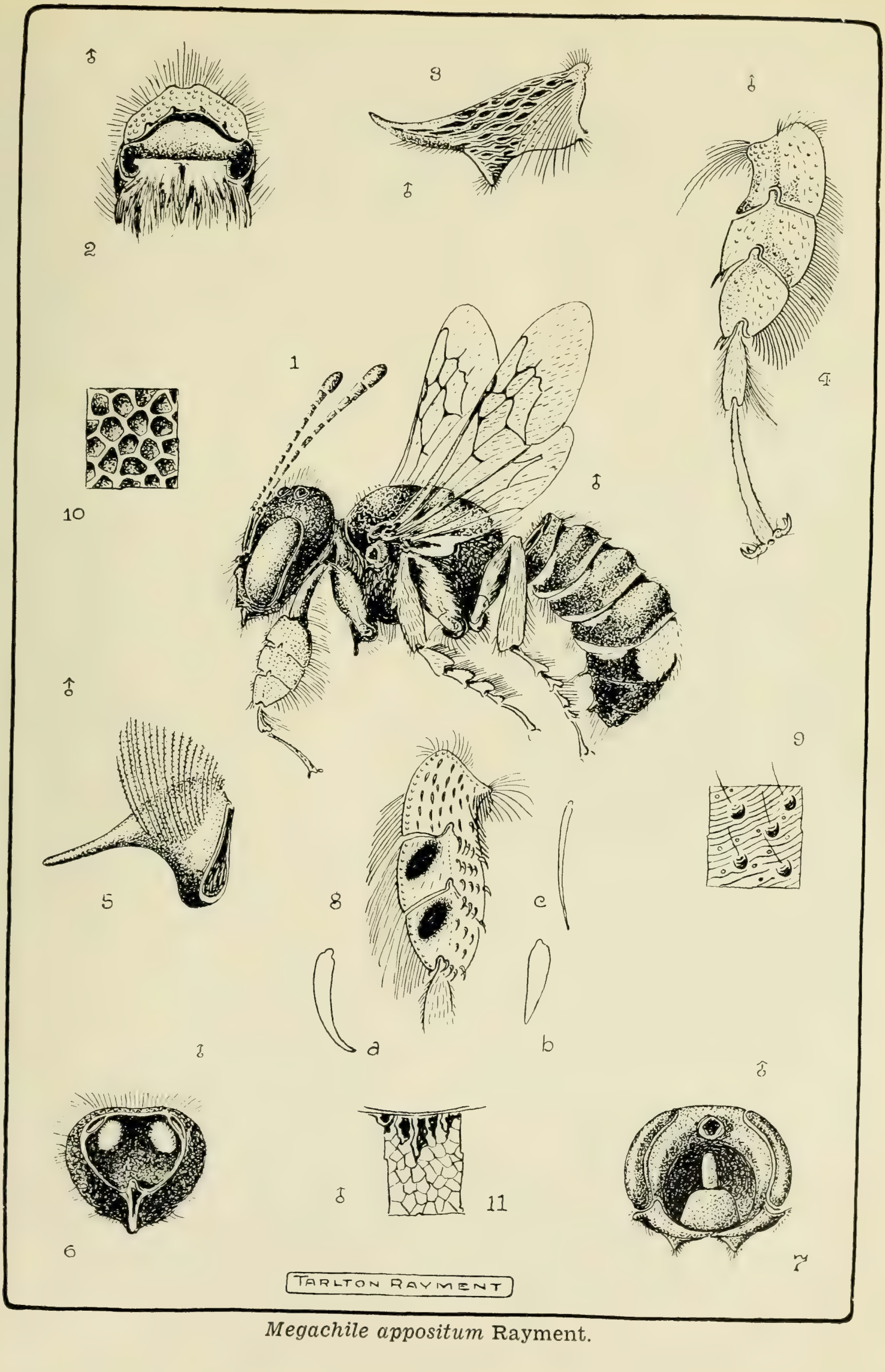


Fig. 2. *Phasmichthys lemures* Whitley. Holotype from the Great Australian Bight (Austr. Mus., Regd. No. E.3591.) .. .. .. Mary Soady *del.*

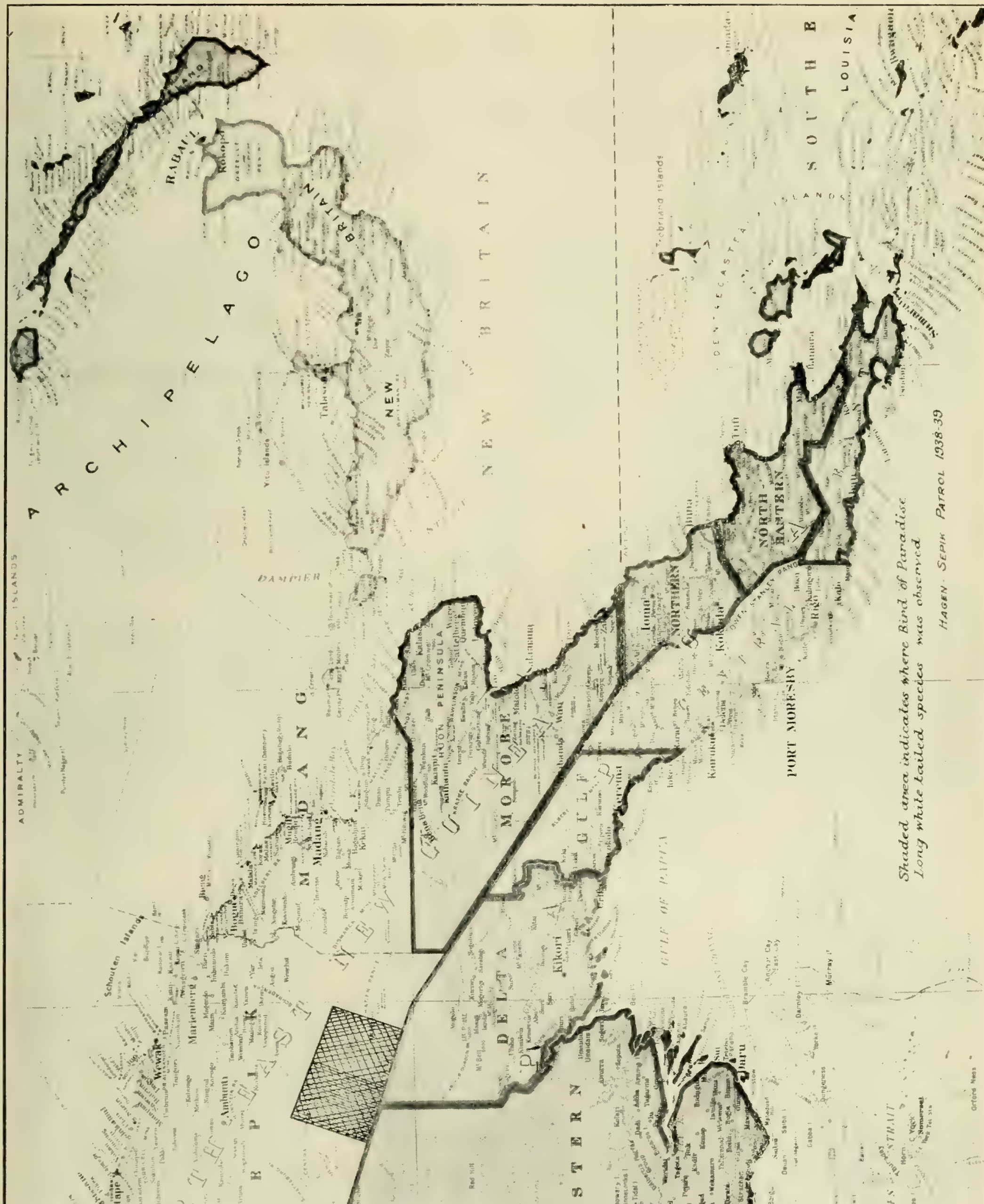


Sphaerhylaeus procurvus Rayment.

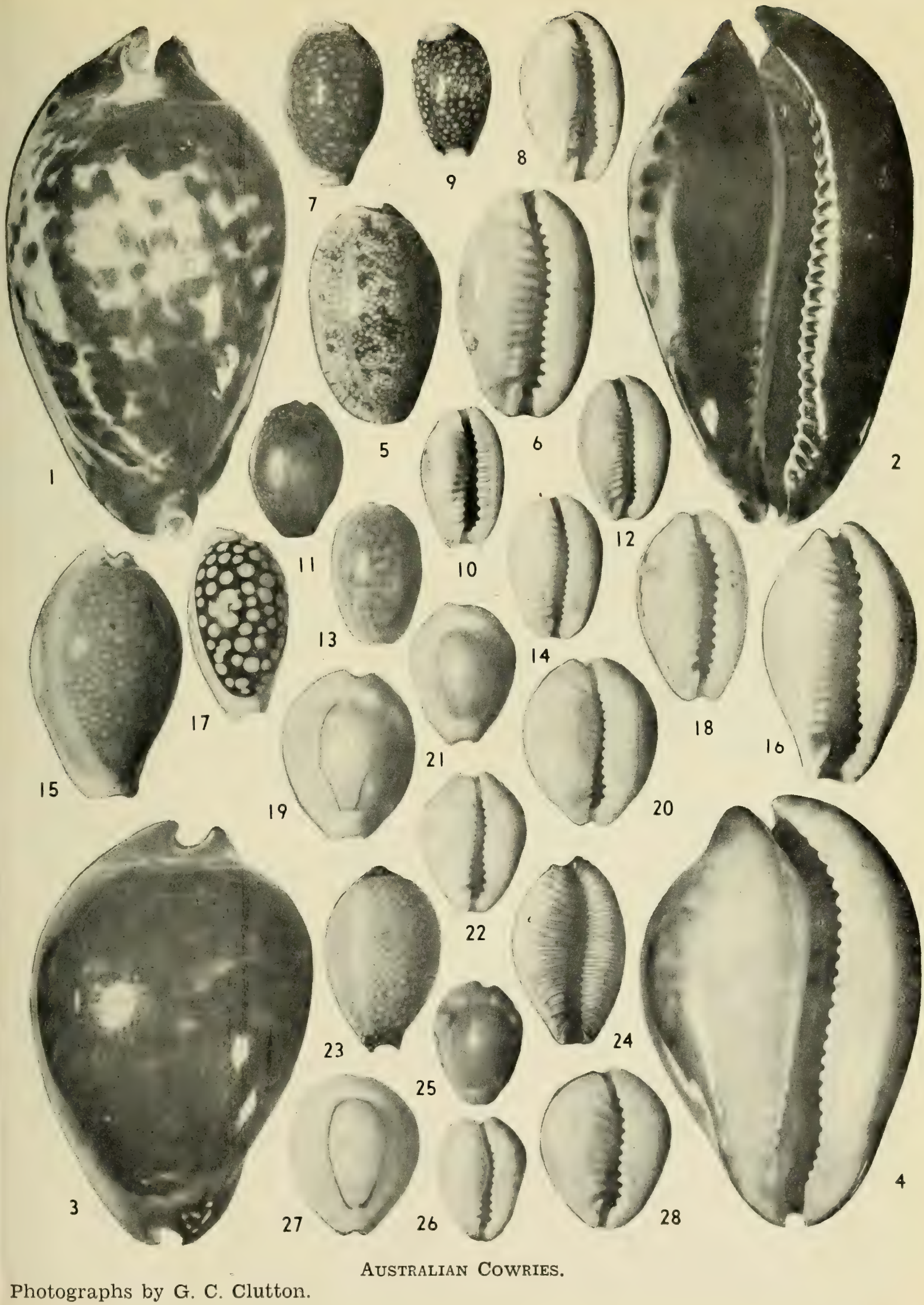


Megachile appositum Rayment.

Taeniaparadisea macnicolli Kinghorn.

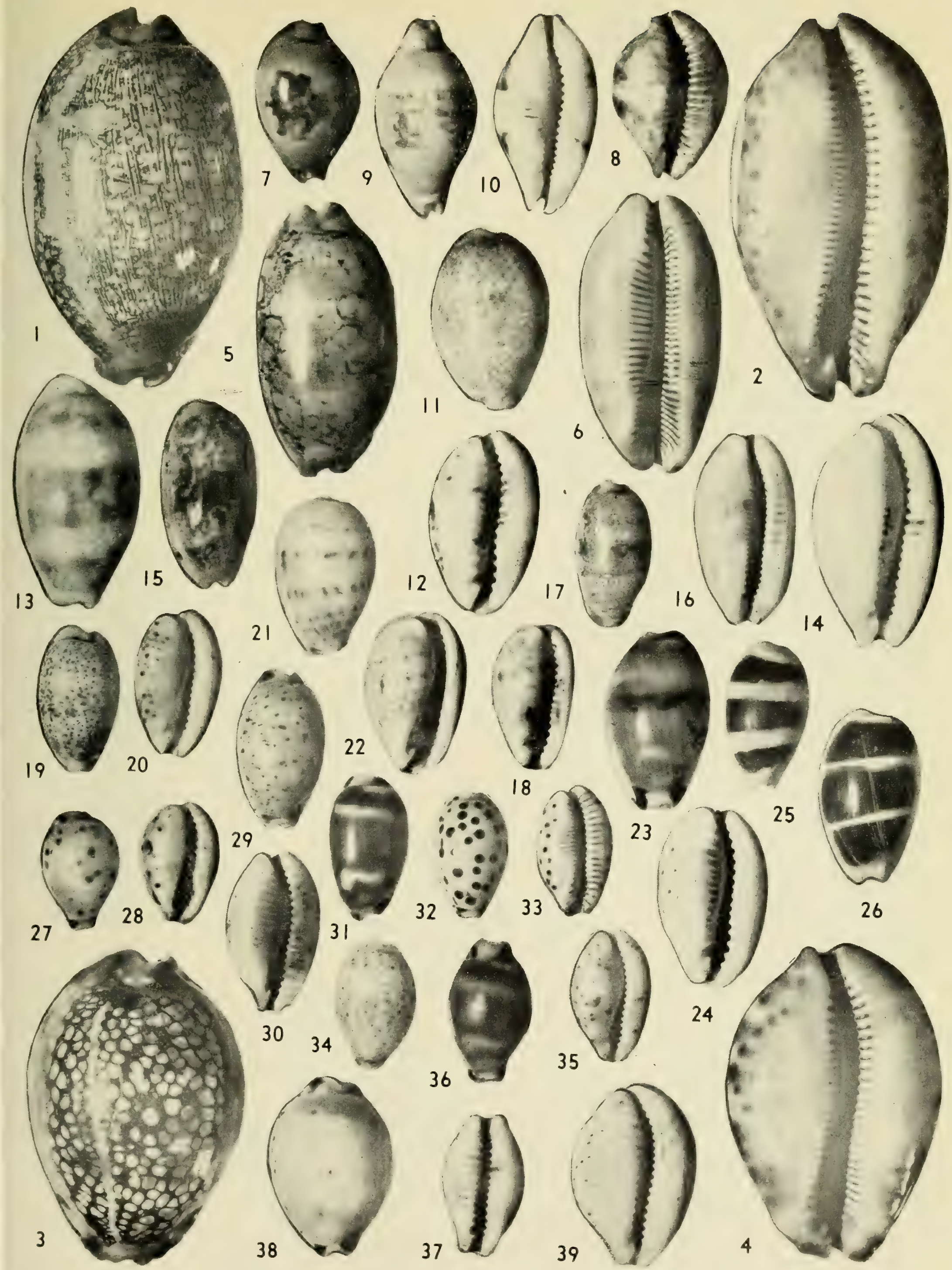


Map showing type locality (shaded) of *Taeniaparadisea macnicolli* Kinghorn.



Australian Cowries.

Photographs by G. C. Clutton.



AUSTRALIAN COWRIES.

Photographs by G. C. Clutton.

AUSTRALIAN COWRIES.

Photographs by G. C. Clutton.

Royal Zoological Society of New South Wales.

MEMBERSHIP.

Class.	*Amount of Subscription.*
Associate Member	5 0 per annum.
Ordinary Member	£1 0 0 „
[Members joining after 1st January in any year pay one-half subscription.]	
Life Associate Member	£2 10 0 in one sum.
Life Member	£10 0 0 „
Honorary Associate Member	No subscription. Elected for services to Australian Zoology or to the Society.
Honorary Member	

TITLES.

(Conferred by the Council.)

Fellow	For distinguished services to Australian Zoology.
Associate Benefactor.	For contribution of £100 to the Society's Funds.
Benefactor	„ „ £500 „ „ „ „
Endowment Member	„ „ £1,000 „ „ „ „

PRIVILEGES.

Members of all classes may attend all meetings of the Society and its various Sections. Every member (other than an Associate or Life Associate member) receives a free pass to Taronga Zoological Park and Aquarium, and twenty tickets each year, admitting 20 adults or 40 children to the Park only.

APPLICATION FOR MEMBERSHIP

should be addressed to the Honorary Secretary, Box 2399 M.M., G.P.O., Sydney, accompanied by a remittance of the amount of subscription. The number of Ordinary Members is limited to 350, and should there be no vacancy at the time of application, the applicant will be registered as an Associate Member, and shall take precedence in accordance with the date of his admission to Associate membership.

PUBLICATIONS.

"The Australian Zoologist"

A Journal containing papers relating to the Zoology of Australia. Published at irregular intervals. Subscription to ordinary members elected prior to July 1, 1933, 1/- per annum; ordinary members elected after June 30, 1933, and all associate members, 2/6 per annum.

Vol. No.	Parts.	Date.	Pp.	Plates.	Price (unbound). £ s. d.
I.	8.	1914-20.	256.	19.	1 0 0
II.	4.	1921-22.	172.	45.	12 6
III.	8.	1922-25.	362.	41.	1 0 0
IV.	6.	1925-27.	362.	49.	1 0 0
V.	4.	1927-29.	362.	41.	1 0 0
VI.	4.	1929-31.	394.	32.	1 0 0
VII.	5.	1931-33.	398.	23.	1 0 0
VIII.	4.	1934-37.	346.	19.	17 6
IX.	1.	1937.	82.	11.	3 0
	2.	1938.	112.	8.	4 6

Note:—Single parts of any volume may be obtained at published prices, less 20 per cent. to members or associates. Prices may be ascertained on application to the Honorary Secretary.

PUBLICATIONS (Continued).

AUSTRALIAN ZOOLOGICAL HANDBOOKS.

Check-List of the Fishes and Fish-like Animals of New South Wales, by Allan R. McCulloch, Zoologist, Australian Museum, 3rd Edition, with additions by Gilbert P. Whitley. 108 pp., 43 plates. Price, 2/6. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

A Monograph of the Australian Loricates, by Tom Iredale and A. F. Basset Hull. 168 + xiii. pp., 21 plates and portrait. Price, 5/-. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

Bibliography of Australian Entomology, 1775-1930, by Anthony Musgrave, F.E.S. 380 + viii. pp. Price, 10/-. Postage: Australia, 6d. British Possessions, 9d. Foreign, 1/6.

Australian Spiders and Their Allies, by W. W. Froggatt, F.R.Z.S. Price, 2/6. Postage: Australia, 1d.; British Possessions, 2d.; Foreign, 3d.

CONTENTS OF THIS PART.

"THE AUSTRALIAN ZOOLOGIST."

Communications intended for "The Australian Zoologist" should be typewritten.

Authors should state whether proofs and reprints are desired when submitting MS. Fifty reprints of any article appearing under a separate title will be supplied gratis. If more are required, terms may be ascertained on application to the Editor.

THE AUSTRALIAN ZOOLOGIST

Issued by the
Royal Zoological Society of New South Wales

Edited by
A. F. BASSET HULL, M.B.E., F.R.Z.S.

Vol. 9—Part 4

Sydney, December 9, 1940.

(Price, 7/6).

All communications to be addressed to the Hon. Secretary,
Box 2399 M.M., General Post Office, Sydney.

Sydney:
The Sydney and Melbourne Publishing Co., Pty., Ltd., 29 Alberta St., Sydney.

London:
Wheldon & Wesley, Ltd., 2, 3, and 4 Arthur Street, New Oxford Street, W.C.2.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

Royal Zoological Society of New South Wales.

Established 1879.

REGISTERED UNDER THE COMPANIES ACT, 1899 (1917).

Patrons.

His Excellency the Governor of New South Wales,
The Lord Wakehurst, K.C.M.G.

Sir Philip Woolcott Game, G.B.E., K.C.B., D.S.O.

COUNCIL, 1940-1941.

President: Gilbert Percy Whitley, F.R.Z.S.

***Vice-Presidents*:**

Keith Alfred Hindwood, C.F.A.O.U., F.R.Z.S., A. F. Basset Hull, M.B.E., F.R.Z.S., Albert Littlejohn, and Noel Lee Roberts.

***Members*:**

Ernest John Bryce, F.R.G.S.
Neville William Cayley, F.R.Z.S.
Aubrey Halloran, B.A., LL.B.
Garnet Halloran, B.Sc., M.D., F.R.A.C.S., F.R.C.S. (Ed.).
Charles Francis Laseron.
Frank Marshall, C.M.G., D.D.S.
Theodore Cleveland Roughley, B.Sc., F.R.Z.S.
Michael Stanley Reid Sharland.
John Ross Wallace.
Emil Herman Zeck.

***Officers*:**

Honorary Secretary: Tom Iredale, F.R.Z.S.

Assistant Honorary Secretary: Miss Betty French.

Honorary Treasurer: Phillip Shipway.

Honorary Editor: Arthur Francis Basset Hull, M.B.E., F.R.Z.S.

Honorary Librarians: Keith A. Hindwood and M. S. R. Sharland.

Honorary Auditor: Robert John Stiffe, F.C.A. (Aust.).

OFFICERS OF SECTIONS (1940-41).

Avicultural Section.

Chairman: A. H. Brain.
Hon. Secretary: John D. Whaling.

Marine Zoological Section.

Chairman: Melbourne Ward, F.R.Z.S.
Hon. Secretary: Harry B. Lee.

Budgerigar Section.

Chairman: R. J. Murray.
Hon. Secretary: F. Brennan.

Ornithological Section.

Chairman: M. S. R. Sharland.
Hon. Secretary: T. A. Everitt.

General Zoology Section.

Chairman: Melbourne Ward, F.R.Z.S.
Hon. Secretary: I. H. Thomas.

A RECLASSIFICATION OF THE ORDER *ODONATA*.

BASED ON SOME NEW INTERPRETATIONS OF THE VENATION OF THE DRAGONFLY WING.

By R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.R.S., F.R.E.S.†

CONTINUATION AND CONCLUSION.

By F. C. Fraser, Lt.-Col., I.M.S., Retd., M.D., M.R.C.S., L.R.C.P., F.R.E.S.

Part III.

Suborder Anisozygoptera.

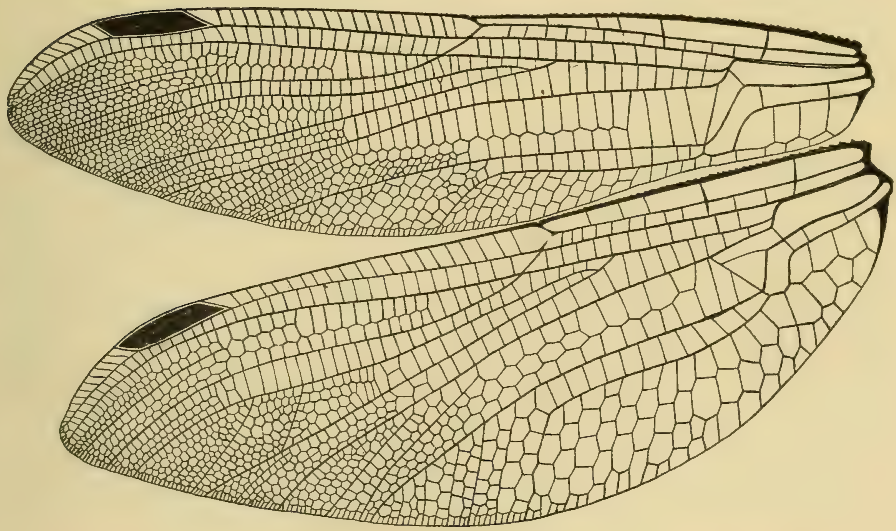


Fig. 1.—Wings of *Heterophlebia buckmani* (Brodie) (*Anisozygoptera*).

The suborder *Anisozygoptera* includes a single recent and a number of Mesozoic genera in which anisopterous and zygopterous characters are found mingled in varying proportions. It marks the transition of the suborder *Anisoptera* from the *Zygoptera*, so that if we examine the extremes of the types, we find at the one end, forms in which zygopterous characters predominate, and at the other, forms which are definitely anisopterous in facies. The whole of the forms found in the Lias belong to the latter category and Tillyard considered that the suborder *Anisozygoptera* should be restricted to include these. Carpenter would further restrict the suborder to include only those forms in which the discoidal cell of the hindwing is divided by a traversing nervure into two cells and differs markedly in shape from that of the forewing. Such a classification would exclude, of

course, the vast majority of the forms and neither author has suggested a new suborder for the inclusion of these.

Nor do I think that a new suborder is required since all the forms which would be excluded possess a mingling of zygopterous and anisopterous characters which is just what Handlirsch implied by his name Anisozygoptera. Of the Jurassic forms, *Tarsophlebia eximia* Hagen, has the base of the hindwing much broader than that of the forewing and there is a marked difference in the shape and inclination of the discoidal cells—both anisopterous characters—for the rest, the long slim abdomen and the long, slender, spider-like legs are zygopterous in nature; *Isophlebia aspasia* Hagen, on the contrary, has the legs short and robust like a Gomphine, and the anal appendages are of distinct Petalurine shape and character—it is a very aberrant form and might equally well belong to the Zygoptera or Anisoptera; *Stenophlebia aequalis* Hagen (Fig. 4c) has the eyes so close together that its head might well belong to a Libelluline; apart from this, its characters are mainly zygopterous. Examples like this may be multiplied, so that I consider a reclassification unnecessary, premature in the present state of our knowledge and possibly artificial if founded on uncertain characters.

If we examine the discoidal cells in any of the Liassic forms of the *Anisozygoptera,* we shall note that the antero-distal angle of the cell in the forewing is obtuse, but in that of the hindwing, either right-angled or more or less acute. This latter has been brought about by a broadening of the hindwing by which the main nervures MA and CuP diverge. In the Jurassic forms, the broadening of the cell is not marked, even where the shape and inclination of the two cells differ in the wings, and therefore the antero-distal angle of the cell in the hindwing is always obtuse. In this character then, we have a means for splitting the suborder *Anisozygoptera* into two superfamilies: the *Tarsophlebioidea* in which the antero-distal angle of the discoidal cell of the hindwing is obtuse, and the *Heterophlebioidea,* in which the same angle of the cell of the hindwing is always acute. I include in this latter the genus *Epiophlebia,* although it is an exception to the rule, but in it, the discoidal cell of the hindwing is often traversed by a nervure as in *Heterophlebia,* and, moreover, the shape of this cell conforms closely to that of the rest of the forms in the superfamily.

Epiophlebia is represented by two recent species, one, *E. superstes* (Selys) which is confined to Japan, being known from both imago and larva, the other, *E. laidlawi* Tillyard, from the larva only. The former species is perhaps the most interesting living form in the whole of the order *Odonata,* for in it we find two different forms illustrating how the discoidal cell, as it exists in the Anisoptera, came to be divided. In a recent paper (1938, Proc. R. ent. Soc. (A), 13 : 155) I have shown that two different systems of venation are found in the species (Fig. 2, 1-3), in one of which the arculus of the fore and hindwings is similar and the discoidal cell of

Fig. 2.—Discoidal cell of:—(1) *Epiophlebia superstes* (Selys), forewing. (2) The same: Forma 1, hindwing. (3) The same: Forma 2, hindwing; note the cell is here divided. (4) *Liassophlebia magnifica* Tillyard, hindwing. (5) *Heterophlebia buckmani* (Brodie), forewing. (6) The same: hindwing. Compare with 4.

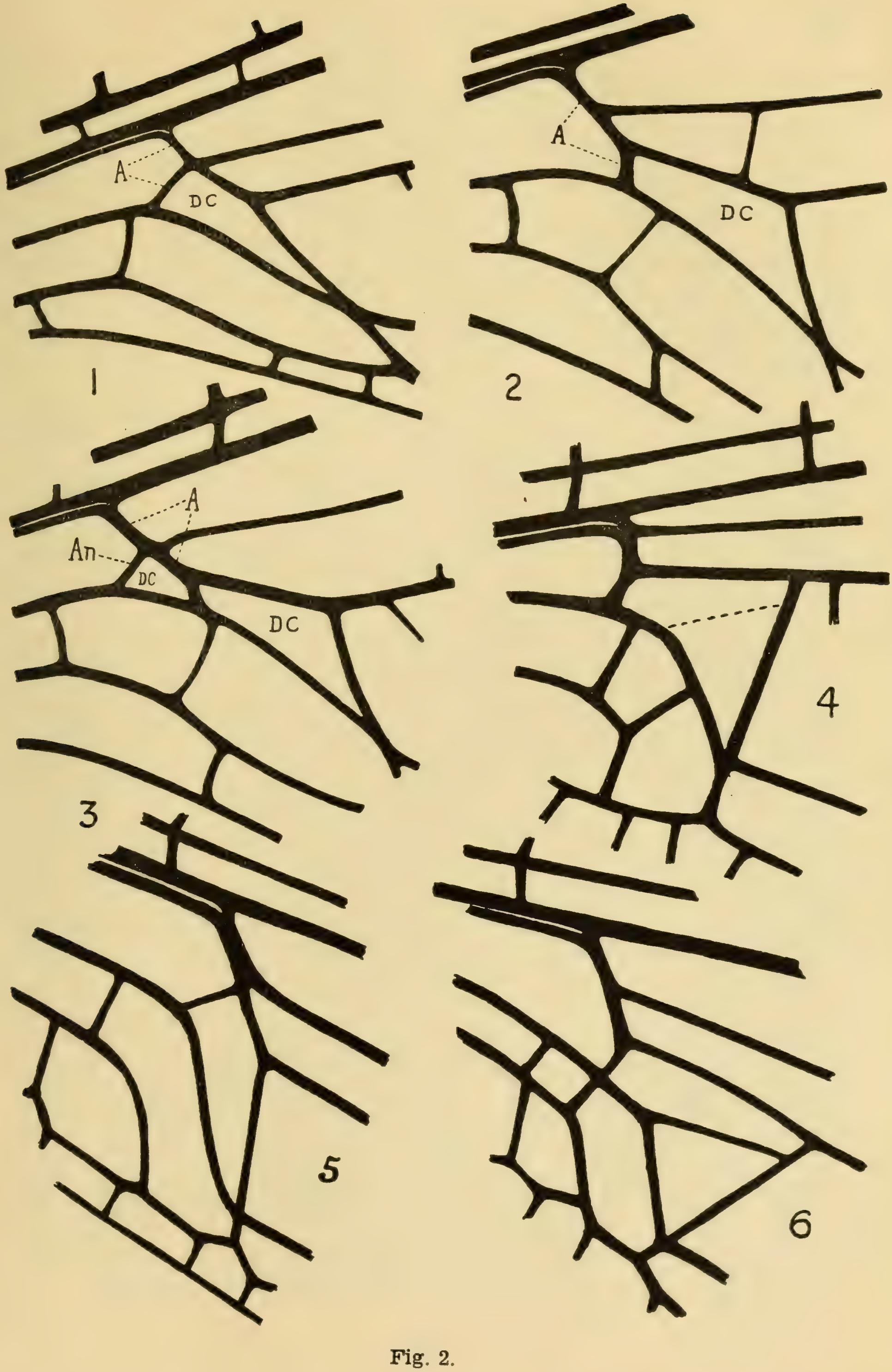


Fig. 2.

the hindwing is crossed and divided by an oblique vein. In the other form, the lower arculus is absent, its place or function being taken by the above-mentioned oblique vein. The first form thus agrees with the Liassic genus *Heterophlebia* in having a simple zygopterous undivided cell in the forewing, and a dilated, divided anisopterous cell in the hindwing. It seems clear that the dividing vein was acquired originally to take the place of the lower arculus, but that both were retained in some forms which ultimately gave rise to the *Anisoptera.* From the shape of the discoidal cell in the hindwing of *Liassophlebia magnifica* Tillyard (Fig. 2, 4), I feel convinced that if we had a series of specimens available, we should find that two forms of venation existed similar to those found in *Epiophlebia*; similarly, in forms like *Petrophlebia anglicana* Tillyard, the existing lower arculus may represent a more distal vein which has taken the place of the original lower arculus.

In *Progonophlebia woodwardi* Tillyard, the structure of the base of the discoidal cell and the arculus is obscured but the poorly preserved vein at the base of the former does not appear to represent the lower arculus and there is the beginning of another vein more proximal to it. In *Progonophlebia brodiana* sp. nov. (= *Anisopteron brodianum* Handl.) the base of the discoidal cell is more proximal and there is another cross-vein in the median space proximal to it, which may indicate a division of the cell as in *Epiophlebia.* (It is unfortunate that Dr. Tillyard overlooked this species and that Handlirsch failed to recognise the genus to which it belonged.)

I do not propose to discuss here the forms belonging to the *Tarsophlebioidea* since they represent blind alleys and all species became extinct. Of the *Heterophlebioidea,* apart from *Epiophlebia,* the various species of the genus *Heterophlebia* Westwood, are the most important since the venation of the wings gives us a graphic description of the transition of the *Anisoptera* from the *Zygoptera.* (Fig. 1.) In the forewing, the base of which is very narrow, the discoidal cell is a narrow, acutely angled quadrangle such as we find in any of the small damsel-flies of to-day; its formation could not be more typically zygopterous. We note only that the arculus has recessed and now occupies a position nearly midway between the primary antenodals, and that the two sectors Riv + v and IRiii have recessed to a degree somewhat less than what we find in the *Amphipterygidae.* The antenodal complex is however a very close copy of what we find in this latter family, viz., in such forms as *Diphlebia,* etc. (In *Epiophlebia* the antenodal complex has advanced a stage beyond *Heterophlebia* and resembles that found in the anisopterous family *Gomphidae.*) In the hindwing of *Heterophlebia* the discoidal cell is very different from that of the forewing, and in shape and by its division into two cells, is as much an anisopterous structure as the cell of the forewing is a zygopterous one. Moreover, the base of the hindwing is greatly broadened as in the *Anisoptera.* The whole story of the descent of the *Anisoptera* from the *Zygoptera* is written in the venation of the wings and the anatomy of this genus and other Liassic dragonflies, for it was necessary that there should be a mingling of zygopterous and anisopterous characters in the passage from one to the other. The presence of such transitional forms is quite meaningless if we accept Carpenter's theory of the origin of the *Anisoptera* from some Permian Protanisopterous ancestor.

The classification of the suborder *Anisozygoptera* is as follows:—

Suborder ANISOZYGOPTERA Handlirsch.
Family TARSOPHLEBIOIDEA.

Family 1. *Tarsophlebiidae* Hand. Genera: *Tarsophlebia* Hagen, *Tarsophlebiopsis* Till., *Karatawia* Martyn.
2. *Isophlebiidae* Handl. Genera: *Isophlebia* Hagen, *Anisophlebia* Handl.
3. *Mesophlebiidae* Handl. Genera: *Mesophlebia* Tillyard, *Triassophlebia* Tillyard.
4. *Sublosiidae* Handl. Genera: *Sublosia* Handl. (Oligocene).
Inc. sed.: *Heterothemis* Handl., *Liadothemis* Handl., *Oryctothemis* Handl., *Palaeophlebia* B., R. & G., *Parelthothemis* Handl., *Perissophlebia* Tillyard, *Petrothemis* Handl., *Anormothemis* Handl., *Systellothemis* Handl., *Rhabdothemis* Handl., *Pycnothemis* Handl., *Temnothemis* Handl.

Superfamily HETEROPHLEBIOIDEA.

Family 1. *Liassophlebiidae* Tillyard. Genera: *Liassophlebia* Tillyard.
2. *Archithemidae* Handl. Genera: *Archithemis* Handl., *Petrophlebia* Tillyard, *Diastatommites* Handl., *Campterophlebia* Bode, *Selenothemis* Handl.
3. *Progonophlebiidae* Tillyard. Genera: *Progonophlebia* Tillyard.
4. *Heterophlebiidae* Handl. Genera: *Heterophlebia* Westwood.
5. *Epiophlebiidae* Tillyard. Genera: *Epiophlebia* Calv.
6. *Liassogomphidae* nom. nov. Genera: *Liassogomphus* Cowley.

Dr. Tillyard, in his "British Liassic Dragonflies", p. 12, has treated *Petrophlebia* as a separate family, giving as his reasons the absence of the two "hypertrophies antenodals", but although the primary antenodals cannot be made out in the fossil, it is certain that they must be present since these two structures are ordinal characters and are only found suppressed in the most recent families of the *Zygoptera* and *Anisoptera*. For this reason I have merged it with the *Archithemidae*. In a revision of the work quoted, I feel sure that the author would have merged the two families, for he says:—"In spite of the given venational differences, it seems to me that this genus is very closely related to *Diastatommites* Handl. (*Archithemidae*) which it greatly resembles in the form of the discoidal field and the cubito-anal area".

Suborder ANISOPTERA.

The suborder Anisoptera is divided up into six families containing forms which, in regard to their wing venation and powers of flight, show the highest development yet attained in the order *Odonata*. All six families agree in having the discoidal cell of both wings divided into two, an anterior or "hypertriangle" and a posterior or "discoidal triangle". The latter may be again split up into two or more cells by traversing veins and, indeed, in some species is made up of a dense reticulation of veinlets. Even in the latter, however, the original dividing vein or veins may be made out as a rule. The base of the hindwing is usually considerably broadened, but in the supposedly archaic forms this may be either not marked or altogether absent, though the wings are never petiolated as in the *Zygoptera*. The pterostigma is invariably present in both fore and hindwings and is usually

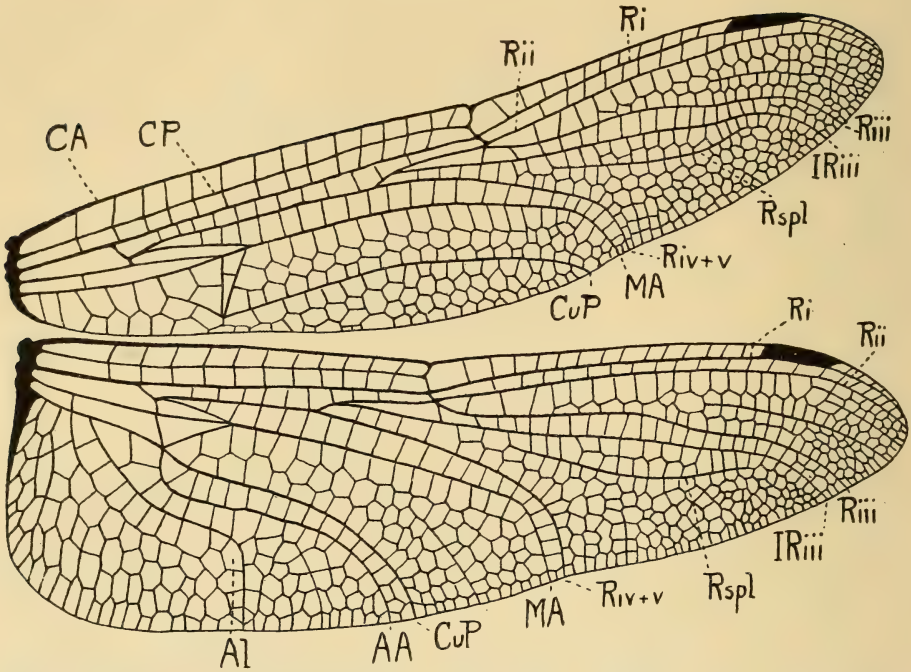


Fig. 3.—Wing of an Anisopterous dragonfly (*Libellulidae*). AA.—Analis anticus. Al.—Anal-loop. CA.—Costalis anticus. CP.—Costalis posticus (Sub-costa). CuP.—Cubitus posticus. Rspl.—Radial supplement. R.—Radius and its branches. MA.—Medianus anticus.

of elongated, Lestine shape and braced or unbraced. Except in the *Libellulidae* and a few aberrant recent genera of the *Aeshnidae* and *Corduliidae,* the base of the hindwing in the male is more or less angulated and excised, but it is always rounded in the female of all families.

The eyes exhibit a wide differentiation from being widely separated in the *Gomphidae,* more slightly so in the *Cordulegasteridae* and *Petaluridae,* to a wide confluence across the middle line of the head in the other families. They reach their greatest size and confluence in the Aeshnidae. Since separation of the eyes is common to the whole of the suborder *Zygoptera,* its presence in these three families must be regarded as an archaic character, and the *Gomphidae,* in which it is most pronounced, the most archaic of all the six families.

The shape of the abdomen exhibits an even greater differentiation, even within individual families; thus in the *Libellulidae* the abdomen may be longly or shortly cylindrical, longer or shorter than the wings, fusiform or tapered to the end, strongly carinated on the dorsum or markedly depressed. In many females, the 8th and 9th segments are foliately dilated, and this specialisation appears to be the outcome of the loss of the primitive zygopterous ovipositor, the lateral expansions of the segments taking on its function.

In general, the secondary sexual apparatus of the male is similar to that of the *Zygoptera,* although perhaps more highly specialized. The

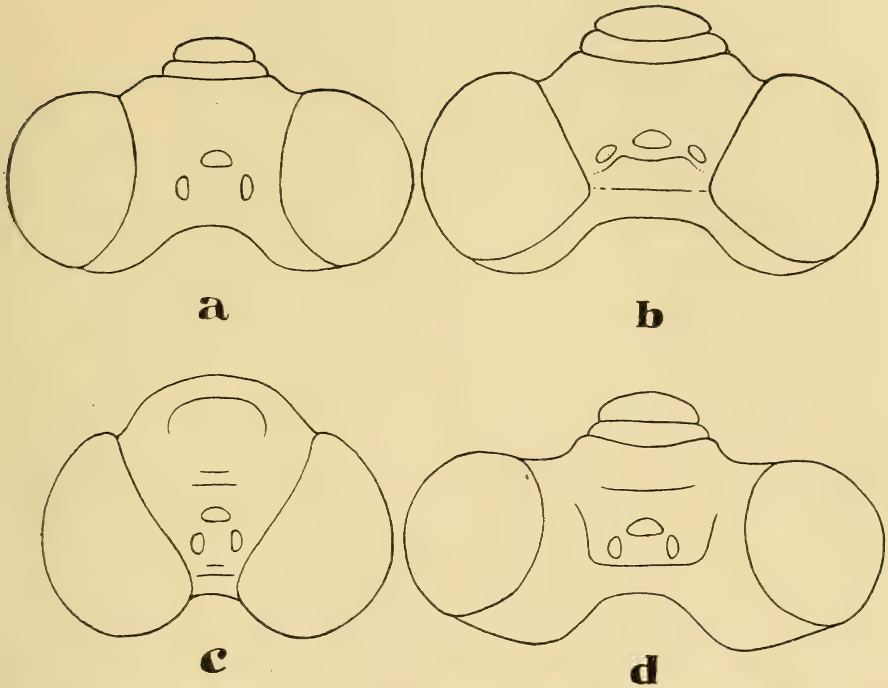


Fig. 4.—Outline of heads of:—(a) *Heterophlebia buckmani* (Brodie). (b) *Heliogomphus promelas* (Selys). (c) *Stenophlebia* sp. (The head is somewhat distorted from pressure.) (d) *Epallage fatima* Charp.

female genitalia, however, exhibits various stages of evolution, the *Aeshnidae* and *Petaluridae* still retaining the zygopterous ovipositor, whilst this organ is present in a degraded condition in the *Cordulegasteridae* and entirely absent or atrophied in all the other families. It may be said that if the female genitalia be taken as a criterion, then the *Aeshnidae* are every bit as archaic as the *Gomphidae*.

In the face of such equivocal evidence, it is necessary to seek elsewhere for characters by which the relationships and phylogeny of the six families may be interpreted. Fortunately we find such characters exhibited by the larval forms belonging to the various families, many of which are now well known.

The general shape of the larvae differs markedly between the families and, in the case of the *Gomphidae,* within the family itself. It is only when we come to look into details that we find a greater homogeneity exists, especially in such organs as the labium and the gizzard. By employing these latter, it is possible to establish relationships between the families and even between these and the *Zygoptera*.

The Labium. (Fig. 5.)

Two very definite types of labium exist in the Anisopterous larvae—a flat type which closely resembles that of the *Zygoptera* and which has obviously been derived from that suborder, and a cupped or deeply concave

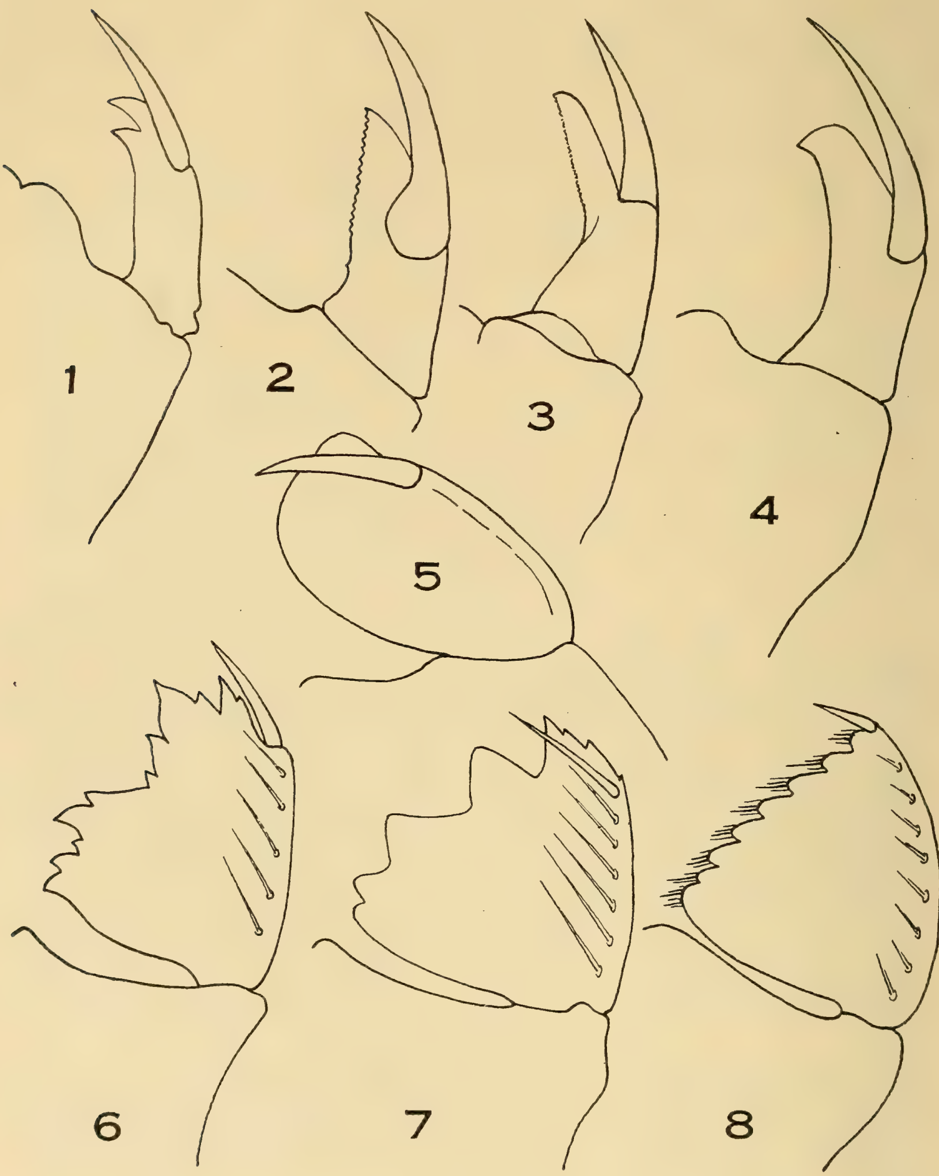


Fig. 5.—Labial masks of:—(1) Agrionine. (2) Austrogomphus. (3) Austropetalia. (4) Aeshna. (5) Petalura. (6) Cordulegaster. (7) Synthemis. (8) Libelluline.

type, which is a recent development peculiar to the *Anisoptera*. To the former type belong the *Heterophlebiidae* of the *Anisozygoptera* as evidenced by the larva of *Epiophlebia*, the only living forms belonging to this suborder; in it the labium is almost identical to that of the *Gomphidae*, differing only by the shorter and less robust movable hook, which, of course, is a zygopterous character. To this type also belong the *Gomphidae* and *Aeshnidae* which are thus seen to be the most archaic of the Anisopterous families. The *Petaluridae* possess a labium which conforms to neither type, but which, from its shape, appears to show a passage from the flat to the concave type; an appearance which, I think, is more apparent than real. From the small size of the movable hook as compared to that of the lateral lobe, the inclination appears to be towards the *Anisoptera*. The remaining three families *Cordulegasteridae*, *Corduliidae* and *Libellulidae* all belong to the concave type. The Cordulegasteridae labium has the lateral lobe broadly triangular and deeply serrate and biserrate along the inner border; the primitive Corduline larva is very similar to this but lacks the biserrations. A study of the labia in the Australian genera *Cordulephya*, *Synthemis*, *Choristhemis* and *Eusynthemis* reveals a complete series which exhibits serrations as deep as those in *Cordugaster*, to others in which they begin to assume the crenately bordered labia of the higher *Corduliidae* and *Libellulidae*. Another similarity between *Synthemis* and *Cordulegaster* must be mentioned here, viz., the presence of a frontal plate on the head, a character shared only by these dragonfly larvae.

The Gizzard. (Fig. 6.)

The gizzard of Odonate larvae has the lining membrane gathered up into a number of folds varying from 16 in the primitive *Zygoptera* and *Anisozygoptera* (*Epiophlebia*) to 8 or 4 in the *Anisoptera*. The folds are armed with chitinous teeth numbering from 20 to 1, and are alternately long and short where the folds are numerous. The reduction in the number of folds has probably been brought about by suppression of the minor folds or by an amalgamation of these folds with the major ones, thus the exact stage at which this evolutionary process has arrived at in the various families is of great phylogenetic significance. The reduction in the number and the shape of the teeth is of equal importance. In the imago, the gizzard exists as an atrophied structure and the dentition is either greatly reduced as in the *Zygoptera* or altogether lost as in the *Lestidae* and *Anisoptera*. In this we see yet another link established between a Lestid form of ancestor and the *Anisoptera*. The *Zygoptera* and *Anisozygoptera* stand at the foot of the series with 16 folds armed with numerous teeth; the *Petaluridae* follow with 8 folds but armed with only one or two teeth; the remaining families of the *Anisoptera* have only 4 folds, but these, in the *Gomphidae*, are furnished with numerous teeth as in the *Zygoptera*. The *Aeshnidae* show a great reduction in the number of teeth which are more specialized and much more robust in character. Finally the *Cordulegasteridae*, *Corduliidae* and *Libellulidae* have but one tooth per fold, thus paralleling the evidence afforded by a study of the larval labium.

One other important character remains to be discussed, viz., the presence of membranous keel-like armature on the tibiae of the *Chlorogomphinae* (*Cordulegasteridae*) and the *Corduliidae*. Taken in conjunction with the evidence afforded by the labial mask, the frontal ridge and the form of the gizzard, these tibial keels seem to me to indicate a descent of the higher *Anisoptera* (*Corduliidae* and *Libellulidae*) from a Cordulegasterine ancestor, and a common origin with the *Chlorogomphinae*.

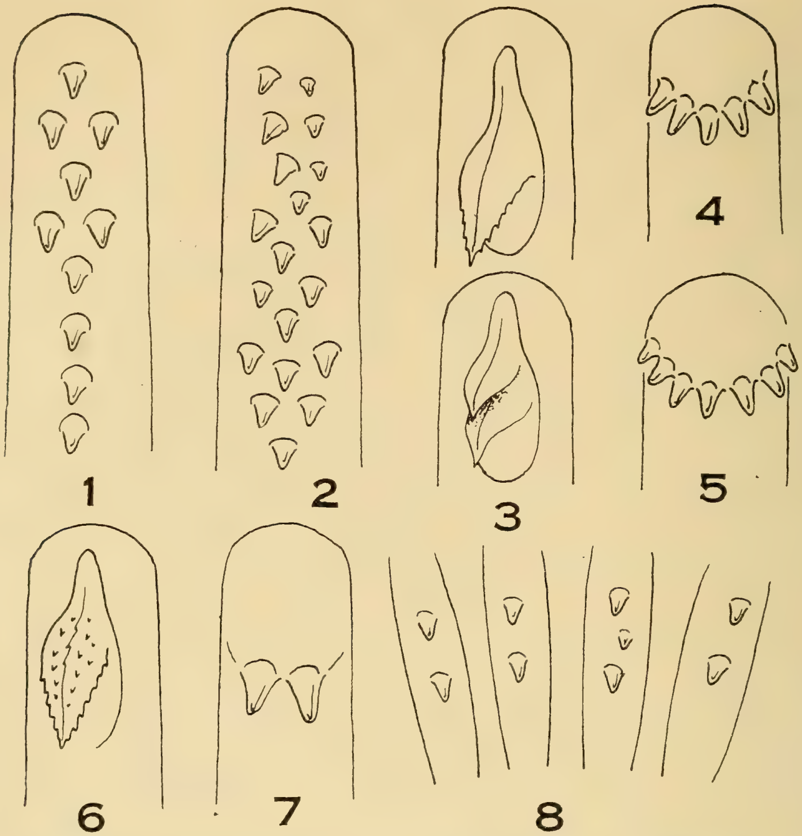


Fig. 6.—Gizzard armature in:—(1) Amphipterygine (*Diphlebia*). (2) Gomphine (*Austrogomphus*). (3) Corduline and Libelluline. (4) Lestine (*Austrolestes*). (5) Aeshnine (*Aeshna*). (6) Cordulegasterine (*Chlorogomphus*). (7) Petalurine (*Petalura*). Four of the 8 folds are shown of this last.

To sum up the evidence, it would appear that the *Gomphidae* have adhered most closely to the ancient Anisozygopterous line, the only living descendants of which are the two species of *Epiophlebiasuperstes* (Selys) and *laidlawi* Tillyard. The *Aeshnidae* and *Petaluridae* arose later from the *Anisozygoptera* and still inherit some zygopterous characters which had been preserved in that ancient line after the departure of the *Gomphidae*. From this Aeshnid line arose the *Cordulegasteridae* which later threw off the common ancestor of the *Chlorogomphinae* and *Corduliidae*, from the latter of which arose the *Libellulidae*.

The Fossil history of the *Anisoptera*.

The *Anisoptera* first make their appearance in the Jurassic, where are found forms which are closely related to the present-day *Gomphidae*, *Petaluridae* and *Cordulegasteridae*. The problematical form *Liassogomphus brodei* (Buck), which Handlirsch and Tillyard placed in the *Gomphidae* but

which the latter subsequently relegated to the *Anisozygoptera*, I would regard as an annectant form between that suborder and the *Gomphidae*; apart from this, no *Anisoptera* are known from the Liassic. In the Cretaceous, only a single dragonfly is known, which is probably related to the *Aeshnidae*. From the Tertiary deposits a large number of Anisopterous forms are known, most of which so closely resemble those of to-day, that they are of small use for tracing the phylogeny of the latter. The *Libellulidae*, the most recent of all Odonata, are first found in the Miocene, if we except a single Corduline genus from the Oligocene of N. America.

Key to the families of the *Anisoptera*.

1. Antenodal complex complete; primary antenodals absent or atrophic. .. .. .. 5.
   Antenodal complex incomplete; primary antenodals well-defined. .. .. .. 2.

2. Eyes broadly contiguous over middorsum of head; discoidal cells of fore and hindwings of similar shape and situated equally far from the arculus; female with a complete zygopterous ovipositor .. .. .. *Aeshnidae*.
   Eyes more or less separated over dorsum of head; discoidal cells of fore and hindwings similar or dissimilar; female with or without zygopterous ovipositor. .. .. .. 3.

3. Middle lobe of labium with deep median fissure; eyes only moderately separated above; female with a zygopterous or pseudozygopterous ovipositor. .. .. .. 4.
   Middle lobe of labium entire; eyes widely separated above; female without zygopterous ovipositor. .. .. .. *Gomphidae*.

4. Pterostigma moderately long and slender; superior anal appendages of male narrow and acute at apex; female with a pseudozygopterous ovipositor. .. .. .. *Cordulegasteridae*.
   Pterostigma enormously long and extremely slender; superior anal appendages of male broadly triangular, obtuse at apex; female with complete zygopterous ovipositor. .. .. .. *Petaluridae*.

5. Primary antenodal nervures present but atrophied and inconspicuous; base of hindwing in male angulated; ear-shaped processes (*auricles*) on the sides of the 2nd abdominal segment of male; tibiae of male with keel-like armature; species nearly always metallic green or coppery metallic. .. .. *Corduliidae*.
   Primary antenodal nervures always absent; base of hindwing in both sexes rounded; auricles never present; tibiae never armed with keels species rarely metallic. .. .. .. *Libellulidae*.

Superfamily Aeshnoidea Tillyard emend.

Forms with the following archaic characters:—Eyes separated, zygopterous ovipositor fitted for inserting ova into plant tissues, larva with flat labial mask, setae absent (except in genus *Gynacantha* of the *Aeshnidae*), gizzard with more than a single tooth per fold. In the *Gomphidae* the eyes are separated but the ovipositor is not of the zygopterous type; in the *Aeshnidae* the eyes are confluent and the ovipositor is of the zygopterous type; lastly, in the *Petaluridae* the eyes are separated and the ovipositor is of the zygopterous type. It will be seen that such a distribution of characters is of a transitional nature, as the following formula shows:—

Family.	Eyes separated.	Zygopterous ovipositor.
Gomphidae	+	—
Petaluridae	+	+
Aeshnidae	—	+

Other characters separating these three families will be found in the key given above.

Family I. Gomphidae.

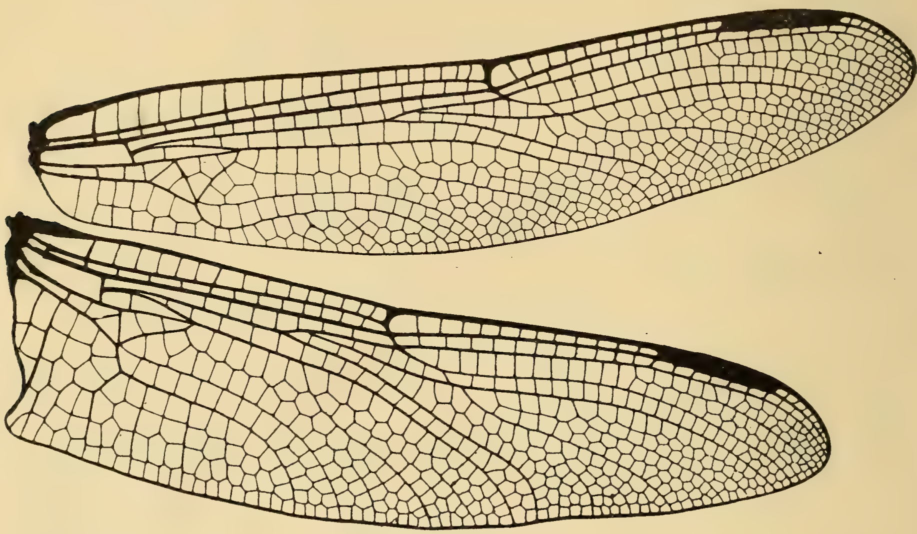


Fig. 7.—Wings of *Gomphidae* (*Ictinogomphus*), male.

The *Gomphidae* is a large family containing forms of clearly defined, homogeneous facies and all coloured black and yellow; sometimes one and sometimes the other colour preponderating. Generally those species confined to heavily forested areas are black marked sparingly with yellow, whilst those inhabiting more open country and desert zones, are yellow with more or less dark markings. The wings are always hyaline and uncoloured; the antenodal complex shows but a slight advance on that of *Heterophlebia*, the secondary veins being more numerous and present in both costal and subcostal spaces as in *Liassogomphus*. The base of the hindwing, in the male, is strongly angulated and excised, except in the more archaic genera; the discoidal cells are short and of different shape in the fore and hindwings, that of the latter being more elongated. At the base of each cell, another triangular cell appears for the first time—the "subtriangle", and posterior to this, although in a rudimentary condition, there may be a compact group of cells enclosed by the anal veins and known as the *"anal-loop"*. The head is transversely elongate as in the *Zygoptera* and the eyes are widely separated. The abdomen varies in shape in the genera, especially in regard to the end segments, the sides of which may be foliately dilated or elongated. The anal appendages of the male are highly specialized, the inferior being strongly bifid and its branches either

widely splayed or closely apposed and parallel. The female ovipositor is rudimentary and oviposition is accomplished by merely dipping the end of the abdomen in fast running water; the ova are swept off and sink to the bottom of the stream.

The larvae of this family are extremely variable, the body either elongated, fusiform and cylindrical or limpet-shaped or extremely depressed and dilated laterally. This polymorphism is an adaptation to their variable habitats, the fusiform cylindrical forms being adapted for burrowing deep in mud and sand; the depressed ones living at the bottoms of deep pools among leafy trash, where their form and dark blackish brown colouring renders them practically undifferentiated from their surroundings. The former types have the forelegs adapted for digging and the fore and mid-tarsi are only 2-jointed. The labium is of the flat, quadrate type, with narrow lateral lobes, rather obtuse at apex and fitted with a robust movable hook. The gizzard has 4 elongate folds furnished with a large number of undifferentiated teeth as in the *Zygoptera*.

The family is divided up into four subfamilies by venational differences but, generally, the range of these is remarkably small as compared to other Odonata, so that considerable difficulty has been met with in the classification of this family, and it may become necessary eventually to employ other characters for this purpose. Recently I have completed an examination of the penile organs of the whole of the genera of the *Gomphidae* and, although the results have been disappointing for classification purposes, they do not support the present classification by venational characters; thus the penile organs of the Epigomphine genera *Macro* and *Microgomphus* are quite similar to those of the Gomphine genus *Gomphus*, and the organs of the genera into which the latter genus has been split, viz., *Gomphurus, Lanthus* and *Stylurus* are all identical. On the other hand, species belonging to one genus such as *Anisogomphus* Selys, have the penes so entirely different, that it becomes a matter of surprise to find the venation so similar. The same may be said for the genus *Ictinogomphus* Cowley, which I have split up into several genera on the evidence of the penile organs; in these cases, however, there is some support from venational differences.

Key to the families of the *Gomphidae*.

1.	Discoidal cell, hypertriangle and subtriangle all traversed by cross-veins.	*Ictinogomphinae.*
	Discoidal cell, hypertriangle and subtriangle entire or only the discoidal cell traversed by a vein.	2.
2.	At least 3 or 4 cross-veins connecting MA to Rs in the hindwing; forking of Rs unsymmetrical.	*Epigomphinae.*
	Only 2 (rarely 3) cross-veins connecting MA to Rs in the hindwing; forking of Rs symmetrical.	3.
3.	A supplementary longitudinal vein springing from the distal side of discoidal cell; this side of cell concave below origin of supplement; legs enormously long.	*Hageninae.*
	No supplementary longitudinal vein arising from discoidal cell; legs short or of ordinary length.	*Gomphinae.*

The New World forms of the *Ictinogomphinae* differ from those of the Old by possessing an incomplete basal antenodal vein in most or all of the

wings, and it may be necessary to separate these into a new subfamily under the name of the *Gomphoidiinae*.

Genera belonging to the *Gomphidae* by subfamilies are:—

Gomphinae: *Acrogomphus* Laid., *Africogomphus* Fras., *Agriogomphus* Selys, *Altaigomphus* Bart., *Anisogomphus* Selys, *Anormogomphus* Selys, *Archaeogomphus* Will., *Austrogomphus* Selys (Australian), *Burmagomphus* Will., *Cyanogomphus* Selys, *Cornigomphus* Mart., *Cyclogomphus* Selys, *Crenigomphus* Selys, *Davidius* Selys, *Davidioides* Fras., *Dromogomphus* Selys, *Erpetogomphus* Selys, *Gomphus* Leach, *Gomphurus* Need., *Hemigomphus* Selys, *Heterogomphus* Selys, *Ischnogomphus* Will., *Karschiogomphus* Shout., *Lanthus* Need., *Labrogomphus* Need., *Lamelligomphus* Fras., *Lestinogomphus* Mart., *Libyogomphus* Fras., *Megalogomphus* Camp., *Merogomphus* Mart., *Nepogomphus* Fras., *Notogomphus* Selys, *Nihonogomphus* Oguma, *Onychogomphus* Selys, *Octogomphus* Selys, *Oxygomphus* Lacroix, *Ophiogomphus* Selys, *Paragomphus* Cowley, *Platygomphus* Selys, *Perissogomphus* Laid., *Podogomphus* Selys, *Stylogomphus* Fras., *Stylurus* Need., *Phyllogomphus* Selys, *Trigomphus* Bart., *Tragogomphus* Sjos., *Neogomphus* Selys, and *Neurogomphus* Karsch.

Epigomphinae: *Epigomphus* Selys, *Heliogomphus* Laid., *Leptogomphus* Selys, *Macrogomphus* Selys, and *Microgomphus* Selys.

Ictinogomphinae: *Austrictinogomphus* nov. gen., *Cacoides* Cowley, *Diphlebia* Selys, *Diastatomma* Selys, *Desmogomphus* Will., *Gomphidia* Selys, *Ictinogomphus* Cowley, *Indictinogomphus* Fras., (Oriental and Australian), *Lindenia* Vanderl., *Negomphoides* Muttow., *Sinictinogomphus* Fras., *Zonophora* Selys.

Hageninae: *Hagenius* Selys, *Sieboldius* Selys.

Fossil genera: *Nannogomphus* Handl., *Protolindenia* Deichmüller, *Necrogomphus* Camp., and *Phengothemis* Handl. (all Jurassic). *Gomphus, Gomphoides* and *Ictinogomphus* have also been reported from Bavarian amber and the Miocene.

Only two genera are found in Australia, *Ictinogomphus* and *Austrogomphus,* the latter exhibiting such a high degree of specialisation of the genitalia that it must have been isolated from the rest of the family over a vast period.

Family PETALURIDAE Tillyard. (Fig. 8.)

The Petaluridae is the smallest family of the suborder *Anisoptera* and contains only nine species belonging to five genera. Species belonging to this family are the giants of present-day Odonata, one Australian form being the largest dragonfly known. They are the remnants of a once

---

The genus *Austrictinogomphus* is raised here to include a single species —*Ictinus acutus* Laidlaw, which differs from all other species of genus *Ictinogomphus* (= *Ictinus* nom. preoc.) by the superior anal appendages forcipated, inferior appendage with its long fine branches widely divaricate, and, lastly, by the shape of the penile organ which is entirely different from that of any other in the genus.

flourishing and widespread fauna as is evidenced by their broken distribution throughout the world.

The wings are long, narrow, subfalcate and densely reticulated and, as in the *Gomphidae,* they are always hyaline and uncoloured; the antenodal complex is similar to this last family; the base of the hindwing is strongly angulated and excised; the discoidal cells are usually similar in the fore and hindwings, but in *Phenes* and *Tachopteryx,* that of the hindwing is smaller and more oblique; a subtrigone is present in the forewing and is usually divided into 2 or more cells; the anal-loop is small and rudimentary, being usually open posteriorly and made up of not more than 3 to 5 cells; the pterostigma is of enormous length and extremely narrow and

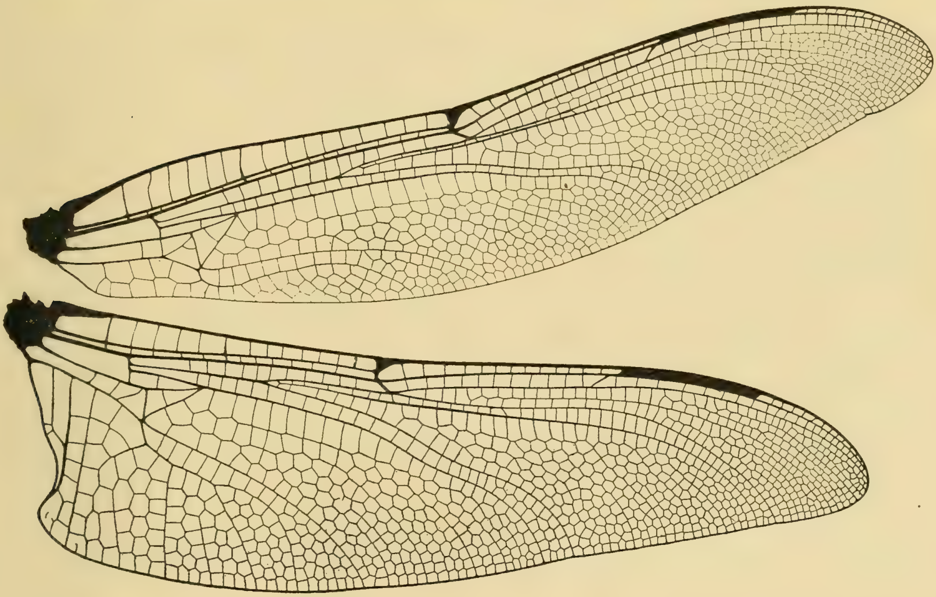


Fig. 8.—Wings of *Petaluridae* (*Uropetala*), male.

is often separated from its brace which lies some distance proximally, especially in *Phenes.* (This feature is not archaic as generally supposed, since the pterostigma is absent in the *Protodonata* and either short or very broad in the earliest known fossil *Odonata.*) The proximal position of the brace suggests that the pterostigma was much longer at one time than it is at present in these forms. The head is massive and the eyes widely separated as in the *Gomphidae*; the abdomen is elongate and cylindrical, with, in some genera, in the female, the end segments deflected dorsalwards so that the zygopterous type of ovipositor comes to look directly posteriorwards in these. The anal appendages are highly specialized, the superiors more or less broadly foliate or triangular except in *Phenes,* and the inferior hastiform or elongate and hook-like.

The larvae, which are best known from Dr. Tillyard's researches on the Australian forms, but also from the N. American *Tachopteryx thoreyi,* are quite the most interesting of the whole order *Odonata,* from their

unique habit of living and burrowing in peaty or marshy soil, into which they may penetrate to a depth of a foot or more, emerging only during the night to seek their prey. The presence of vestigial spiracles in the larvae of all *Odonata,* indicates that this mode of living was, at one time, common to the whole order, so that the *Petaluridae* must be regarded as very archaic; it can be regarded as improbable that the habit has been re-acquired. The larvae are curious grub-like creatures, with soft, whitish elongate body, long spidery legs and flat type of labium found in the *Zygoptera,* but differing from that of the *Gomphidae* by being slightly concave and considerably broadened; the gizzard is of archaic structure in that it is furnished with 8 folds, as in the higher *Zygoptera*, and with small, undifferentiated teeth.

In my monograph on this family in 1932, I divided it up into two subfamilies, but, it must be confessed, on rather slender grounds. Reviewing the *Petaluridae* again, after a lapse of some eight years, I still adhere however to this classification but further restrict the subfamily *Tachopteryginae* to the genus *Tanypteryx*; the name of the subfamily must therefore be changed to *Tanypteryginae.* I do this because, with the whole of the species in review, one cannot help noticing the smaller size and the boldly contrasted colouring of the two species of *Tanypteryx* as contrasted with the huge size and ill-defined, dowdy colouring of the rest of the species belonging to the family; there are also venational differences which are noted in the key below.

Key to the subfamilies of the *Petaluridae.*

Species coloured brown or blackish brown, with poorly contrasted and ill-defined markings of yellow; primary antenodal nervures separated by not less than 4 or 5 secondaries in fore and hindwings. .. *Petalurinae.*

Species coloured black and yellow with strongly contrasted, well-defined markings as in the *Gomphidae*; primary antenodal nervures separated by only 3 secondaries in the forewing and by only 2 in the hind. .. .. *Tanypteryinae.*

Two out of the five known genera and more than half the species are found in Australia and New Zealand. The genera according to subfamilies are:—

Petalurinae: *Petalura* Leach (Australia), *Uropetala* Selys (New Zealand), *Phenes* Rambur (S. America), *Tachopteryx* Selys (N. America). *Tanypteryginae*: *Tanypteryx* Kennedy (N. America and Japan. Fossil genera: *Mesuropetala* Handl., (Jurassic), *Libellulium* West., (= *Cymatophlebia* Handl., (Jurassic).

Family Aeshnidae. (Figs. 9 & 10.)

Insects of large size and robust build, characterised by the large globular head made up in great part by the enormous eyes which are broadly confluent across the middle line of the head. The vesicle is crowded forward and the occiput reduced to a tiny triangular area; the wings are elongate, closely reticulated, hyaline and nearly always uncoloured; the antenodal complex not differing from that of the *Gomphidae,* but in some genera, accessory basal antenodals are found proximal to the primaries, and these are often associated with cross-veins in the median space; the discoidal cells are closely similar in shape in fore and hindwings, and are usually divided up into two or more cells; the anal-loop always present and differing somewhat in shape in the genera, usually subquadrate; pterostigma

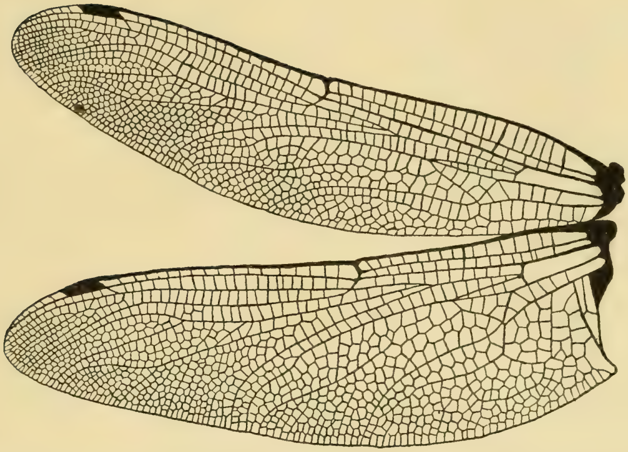


Fig. 9.—Wings of *Aeshnidae* (*Aeshna*). Note oblique veins joining Riv + v and MA.

variable, usually elongate and narrow, braced or not; thorax robust; legs short and robust; abdomen long and cylindrical, with or without lateral ridges on segments 3 to 8; anal appendages very variable, the inferior usually narrowly triangular but, in some genera, broad and more or less emarginate at apical end. Female ovipositor of the archaic zygopterous type, and formed for inserting ova into plant tissues; of variable shape and length and usually furnished with accessory organs or a *"genital plate"*, the function of which is to fix the end of the abdomen whilst the ova are being inserted.

The larvae, which live in weed or crawl on the surface of mud and trash, are very similar in appearance in the genera. Head and eyes broad and flattened; labium of the flat type but very elongate and triangular in shape; lateral lobe of the Gomphine shape but obtuse at apex and furnished here with a robust, inwardly directed spine; setae absent except in the subfamily *Gynacanthaginae.* The gizzard has four folds, each furnished with a few, closely-set teeth approaching the form of a molar.

This family divides naturally into two large sections by the character of the two main veins Riv + v and MA. In the first section, *Aeshnidi,* the vein MA converges on Riv + v and shortly after the level of the nodus, at a point where it begins to turn posteriorwards, it weakens or atrophies or, more usually, is attached to the latter vein by a short oblique cross-vein. At this point, the distal portion of the vein MA shows a distinct bulging away from Riv + v, after which it returns to and runs parallel to that vein. Various degrees of this formation may be found throughout the family, but it reaches its perfection in the genus *Anaciaeshna.* In the second section, *Brachytridi,* there is no sign of this formation, or, at the most, but a slight local curvature of MA; the oblique vein is never present.

Section Brachytridi.

The veins Riv + v and MA running in an unbroken curve and parallel to one another to the wing border or slightly divergent at the distal ends.

The section is divided into three subfamilies by venational and other characters, the principal one of which is the vein IRiii, which may be simple and unbranched or symmetrically forked from a point more or less proximal to the level of the pterostigma.

Key to the subfamilies of the *Brachytridi.*

The vein IRiii simple and unforked. .. .. 2.
The vein IRiii symmetrically forked. .. .. *Brachytrinae.*
A chain of reddish spots along the costal border of all wings; anal-loop absent. .. .. *Neopetalinae.*
Costal border unspotted; anal-loop present. .. .. *Gomphaeshninae.*

Subfamily Gomphaeshninae nov. subfam.

Forms belonging to this subfamily, in addition to the simple unforked condition of IRiii, generally show but a flat curvature of Riii towards the pterostigma, a small anal-loop, a discoidal field beginning with only 2 rows of cells, only 1 or 2 rows of cells between IRiii and the radial supplement (Rspl) and between MA and the median supplement (Mspl), and finally, the discoidal cell of hindwing broader than that of the forewing. Genera are: *Boyeria* MacLach., *Oligoaeshna* Selys, *Allopetalia* Selys, *Gomphaeshna* Selys, *Linaeshna* Mart., *Basiaeshna* Selys, and *Hoploaeshna* Karsch. There are no Australian genera.

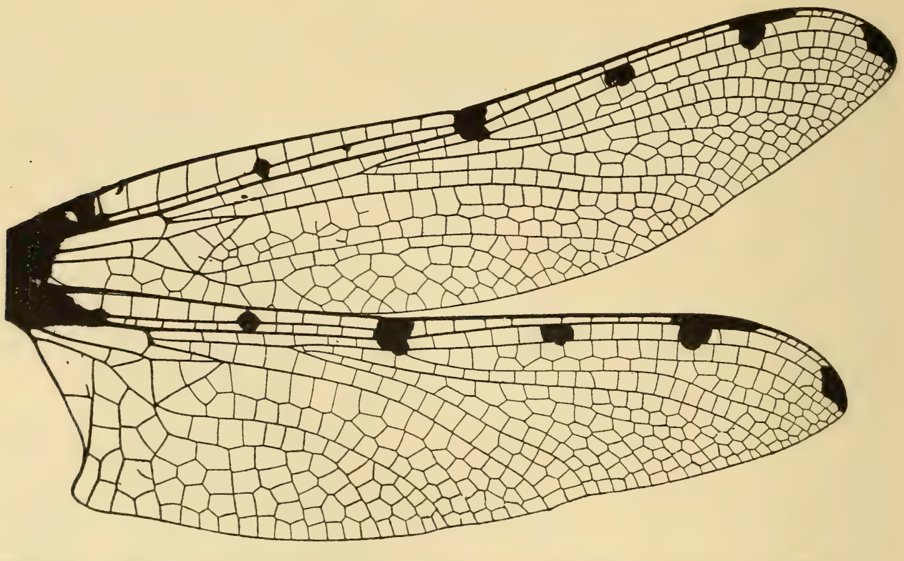


Fig. 10.—Wings of *Neopetalinae* (*Austropetalia patricia* Tillyard), male.

Subfamily Neopetalinae nov. subfam. (Fig. 10.)

This subfamily consists of a small group of monotypic genera characterized by inferior anal appendages of the male trifid at apex and by the costal border of all wings decorated by a chain of ruby-red spots (these are situated at the base, midway between the base and nodus, at the nodus, midway between the latter and the pterostigma, at the pterostigma and apex of wing). The discoidal cells are of the same size and shape and

traversed by a single vein; Rspl is rarely present and Mspl never so; anal-loop absent; IRiii simple and unforked; Riv + v and MA usually diverging towards the wing border; lastly the pterostigmal brace is situated at its middle instead of at the proximal end as in other Aeshnines.

Apart from the remarkable colour scheme of the costal border, the most interesting fact about this small subfamily is its limited distribution to Australasia and S. America. Such a distribution is clearly not a recent occurrence and can only have been achieved when these two countries formed part of a continuous Antarctic continent. This indicates the *Neopetalinae* as of very archaic origin and gives an added importance to their venational characters, since in them, we have a means to estimate the age of other Aeshnines. These characters are: presence or absence of Rspl and Mspl, forked or unforked IRiii, and presence or absence and the relative size of the annal-loop. Eyes separated or just meeting.

Genera are: *Austropetalia* Till., (Australia), *Archipetalia* Till., (Tasmania), *Neopetalia* Cowley, *Hypopetalia* MacLach., and *Phyllopetalia* Selys (all S. America).

Subfamily BRACHYIRINAE nov. subfam.

This large subfamily contains two well-defined groups and a small number of specialized forms which appear to be rather isolated from the rest. One group, the Australian, has the median space free of cross-veins, whilst the other, the Oriental, has the same space traversed by a number of veinlets. In this latter group, the arculus is often situated more distally than in other Aeshnines and usually lies at a level midway between the two primary antenodals or, in some, at the level of or even distal to the outer primary (*Petaliaeshna* Fraser and *Periaeshna* Mart.). Also the female genitalia more nearly approaches the form of the archaic zygopterous organs.

Of the isolated forms, *Austrophlebia* Till., is of enormous size, and nearly equals in this respect, *Petalura ingentissima* Till., another Australian form; its wings are bordered with dark brown along the costa, a cryptic device which harmonizes perfectly with the undersides of tree-fern fronds on which the insect prefers to take its rest. *Telephlebia* Selys, another Australian genus, is remarkable for its rich venation, quite unique in recent *Aeshnoidea*. In it, the space basal to the primary antenodals is filled with coinciding accessory antenodals, as in the higher forms of the *Zygoptera* and *Anisoptera*. With such a formation, we should expect to find the primary antenodals atrophic, but they are still present; it is the one exception which proves the rule. Another rare character is found in this genus, viz., the prolongation of the subcostal vein through and beyond the nodus. This character is also found in two other Aeshnines, the Japanese genus *Aeshnophlebia* Selys, and the Indian genus *Indophlebia* Fraser, although the three are not nearly related. It has been regarded as an archaic character inherited from the ancient Carboniferous *Odonata*, but a little reflection will show that this is a secondary acquirement, since the phylogeny of the Order excludes such a wild theory.

The genera are: (1) Median space free—*Austroaeshna* Selys, *Notoaeshna* Till., *Austrophlebia* Till., (all Australia), *Planaeshna* MacLach., *Aeshnophlebia* Selys (Japan), *Tetracanthagyna* Selys (Oriental), *Epiaeshna* Hagen, *Nasiaeshna* Selys (America), and *Brachytron* Evans (Europe). (2) Median space crossed—*Dendroaeshna* Till., *Telephlebia* Selys (Australia), *Cepha-*

laeshna Selys, *Periaeshna* Mart., *Petaliaeshna* Fraser, *Gynacanthaeshna* Fraser, *Indophlebia* Fraser (Oriental), and *Caliaeshna* Selys (Central Asia).

Section Aeshnidi.

The veins Riv + v and MA gradually converging and either fusing or connected by an oblique vein; MA atrophied at its distal end. This section, which is the dominant one of the *Aeshnidea*, falls naturally into four subfamilies on characters given in the following key:—

Key to subfamilies of the *Aeshnidi*.

1. Hindwing rounded at the base in both sexes; no oreillets on the sides of segment 2; Riii making an abrupt bend towards the pterostigma; anal triangle absent. .. .. *Anactinae*.
   Hindwing angulated and excavated at base in the male; oreillets present on sides of segment 2; Riii not usually making a bend towards the pterostigma; anal triangle always present. .. .. 2.

2. Female genitalia with simple rounded, finely spined dentigerous plate. .. .. *Aeshninae*.
   Female genitalia with dentigerous plate produced into two long robust spines. .. .. *Gynacanthaginae*.
   Female genitalia with dentigerous plate produced and ending in 4 or more robust spines. .. .. *Polycanthaginae*.

Subfamily Aeshninae. (Fig. 9.)

Forms belonging to this subfamily are the most widely distributed and dominant of all the Aeshnines. Their characters are those of the family: MA fused with Riv + v near its distal end; discoidal cells elongate, narrow, of similar shape and size in fore and hindwing; discoidal field beginning with 3 rows of cells; arculus lying at a level much nearer to the proximal primary antenodal; median space entire; subtrigones weak or absent; Rspl and Mspl markedly curved and enclosing between themselves and IRiii and MA respectively 4 or more rows of cells; anal triangle variable, or 2 or 3 cells, narrow or broad; membrane large; pterostigma narrow, of variable length, always braced; IRiii forked shortly before the level of pterostigma. Eyes broadly confluent; abdomen long, cylindrical; anal appendages variable, the inferior usually triangular with acute apex; female dentigerous plate rounded, not produced, coated with numerous fine spines. The subfamily contains only one genus—*Aeshna* Fabr., which is distributed over the whole of northern Asia, Europe and North America. A few species have extended into the montane areas of Central Africa, and others far into S. America. The most remarkable fact, however, concerning the distribution, is the occurrence of a single, typical species in Australia—*A. brevistyla*. The origin of this species and its entire isolation from all other species of a dominant genus is an insoluble problem. *Subaeshna* Mart., (S. America), probably belongs to this subfamily.

Subfamily Anactinae nov. subfam.

Very large and very robust dragonflies with characters similar to the last subfamily but with the hindwing rounded in both sexes, except in genus *Anaciaeshna* which is an annectant between this subfamily and the *Aeshninae*. The oblique vein connecting MA with Riv + v is much better defined in these forms and there is a distinct break in or actual loss of the distal end of MA. In consequence of the rounded nature of the base

of the hindwing, the anal triangle is absent, as also are the oreillets on the sides of segment 2. These latter organs are only present in species with the base of the hindwing notched and it has been thought that they play some part in flight; this is not correct, however, their function being accessories to the genitalia. The deep notch on their hinder border and the imbricated spines on this same border arrest the end of the female abdomen when seeking for the male genital fossa which lies between the oreillets; they are, in fact, a guide to the female during this act. In genera belonging to this subfamily and others with rounded base to wings, other organs are found which have taken over the function of the oreillets, so that the latter have atrophied or disappeared. The abdomen of the male is furnished with supplementary ridges on segments 4 to 8, which are vestigial in *Anaciaeshna* and absent on segment 8, and again in *Oreaeshna*, where they are present only on segments 7 and 8; the anal appendages are not unlike many in the *Aeshninae* but the inferior is usually shorter and obtuse at apex; the female genital plate is quite similar to the *Aeshninae*.

Genera are: *Anax* Leach (*A. guttatus* Burm., is found in Australia), *Hemianax* Selys (*H. papuensis* Burm., is found in Australia). The former genus extends right round the world, both in temperate and tropical zones; the latter extends from Europe to Australia. *Anaciaeshna* Selys (Tropics of the Old World), *Oreaeshna* Lieft., (New Guinea; an annectant form combining the characters of *Anaciaeshna* and *Aeshna*).

Subfamily Gynacanthaginae.

The forms in this large subfamily are remarkably homogeneous in form and colouring and considerable difficulty is often met with in the determination of species; all, with but few exceptions, are crepuscular in habit and all oviposit in dry soil, a circumstance which has led to the evolution of a highly specialized form of ovipositor. The eyes are very large and very broadly confluent; the anal appendages long and thin in both sexes (because of this formation and because of the peculiar nature of oviposition, the appendages of the adult female are nearly always found broken off at the base). The genital plate is produced into a robust two-pronged fork which is employed for digging during oviposition; it is closely similar to that of *Periaeshna* and *Gynacanthaeshna* of the subfamily *Brachytrinae*. Dr. Laidlaw (Proc. U.S. Nat. Mus., 62:3) commenting on this similarity in genera belonging to two different subfamilies is at a loss to know whether we are dealing with a parallel development in venation or genitalia; I think that there can be no doubt that the parallelism is in the evolution of the genitalia, for if we remember that all those species which oviposit in dry earth have such organs, it will be seen that similar habits have called forth similar electic organization. The finely spined organ of the *Aeshninae* would soon become clogged with soil if employed for digging, but the pronged fork of the *Gynacantha* is admirable for such a purpose. The venation of these forms is very similar to that of the *Aeshninae*, but the reticulation is much closer and there is a corresponding increase in the number of cell rows between the Radial and Medial supplements and opposing sectors.

Genera are: *Gynacantha* Rambur (Circumtropical, including Australia), *Austrogynacantha* Tillyard (Australia), *Plattycantha* Martin (Papua), *Cornacantha* Martin (Papua), *Heliaeshna* Selys (Oriental and Ethiopian), *Triacanthagyna* Selys (Central and South America), *Neuraeshna* Selys (South America), *Staurophlebia* Brauer (S. America). The last two genera

resemble *Aeshnophlebia* and *Telephlebia* in having the subcostal vein prolonged through and beyond the nodus, but it is merely another case of parallel development.

Subfamily POLYCANTHAGINAE nov. subfam.

This small subfamily is formed to include a few aberrant forms closely related to the *Aeshninae*. They resemble that subfamily in venation, but the females show a high specialization in their colour and in the formation of their genitalia. The latter has the dentigerous plate prolonged backwards and ending in several robust spines and is employed for digging as in the *Gynacanthaginae*. Unlike this subfamily, species are diurnal in habits, which may account for the bright heliochromatic colouring of the females. There is only one genus, *Polycanthagyna* Fras., (Oriental and Japan).

Fossil genera: In the Tertiary deposits, more especially in the Miocene of Germany, Russia and N. America, a number of genera belonging to the *Aeshnidae* have been described. Of these, Needham is of opinion that only one, *Aeshna solida* Say (Florissant, Miocene), can be considered as belonging to *Aeshna* sens. strict., whilst the others have been placed in recent genera, *Basiaeshna, Hoploaeshna,* or accommodated in new ones, *Morbaeshna* Need., *Lithaeshna* Cock., *Projagoria* Martyn., *Epacantha* Martyn., *Necracantha* Martyn., and *Triaeshna* Campion. Of all these, *Hoploaeshna separata* (Scud) (Miocene, Florissant), is the only one I can find in which MA is defective distally, and so lies within the section *Aeshnidi*; all the others belong to the section *Brachytridi* and to either of the subfamilies *Brachytrinae* or *Gomphaeshninae.*

We are now in a position to discuss the probable ages of the various units which make up the family *Aeshnidae.* Among recent forms, the Neopetalinae appear to be the most archaic, since in them the anal-loop is absent, Rspl and Mspl are elementary or absent, MA is unbroken distally and IRiii is unforked. Lastly, the eyes are separated or only just meet. All these characters agree with those of the mesozoic forms and, so, we can say with certainty that the *Brachytridi* preceded the *Aeshnidi,* and, of the former, the *Gomphaeshninae* preceded the *Brachytrinae.* From the general venation, one would conjecture that the *Aeshnidae* arose from the ancient Petalurine stem; they are at least as old, and probably older than the *Cordulegasteridae,* as the zygopterous type of ovipositor and the more primitive type of larva seem to indicate.

Superfamily CORDULEGASTEROIDEA.

The *Cordulegasteroidea* include the three remaining families of the Anisoptera—*Cordulegasteridae, Corduliidae* and *Libellulidae.* Apart from ordinal characters and the absence of a typical zygopterous ovipositor, no common character exists in the imagines, by which close relationships may

---

The name *"Aeshna"* was emended in Illiger to *"Aeschna",* but has since been restored to its original spelling. Following on this, in this paper, I have emended all the hyphenated names founded on the latter; the International Rules for Nomenclature do not provide for such a contingency, but it seems logical that if a wrongly spelt basic name is emended, then all those founded on the mis-spelt name ought to be so too. *Oploaeschna* Selys is here replaced by *Hoploaeshna* Karsch; *Oploaeshna* was only proposed by Selys and later validated by Karsch, who emended the spelling.

be demonstrated, and it is on the evidence of larval characters that we rely for establishing these. These characters are:—Labium deeply concave and fitting over the face like a gas-mask, plentifully furnished with setae, both on mentum and lateral lobes; the latter with apposed borders biserrate, serrate or crenate; movable hook small and reduced; gizzard with four folds, each fold furnished with a single robust tooth.

Family 1. CORDULEGASTERIDAE. (Figs. 11 & 12.)

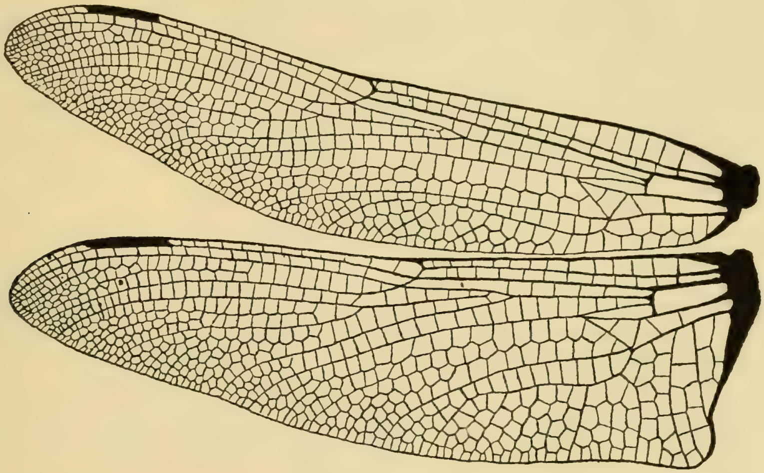


Fig. 11.—Wings of *Cordulegasteridae* (*Cordulegaster annulatus* Latr.), male.

This family contains two large groups of dragonflies which vary so much in facies and detail, that until a few years ago they were considered as not being at all closely related, and it was only the discovery of the larva and an examination of its characters which proved beyond doubt the place of the *Chlorogomphinae* in the family *Cordulegasteridae*. The insects contained in these two groups agree in being of large and robust size, with head transverse and eyes more or less separated, although not to the same extent as in the *Gomphidae*. The larvae, on the other hand, are so closely similar that they are difficult to separate; the body is long and fusiform, tapering towards the end of abdomen; labial mask of the concave or "spoon" shape, with broad triangular, cupped lateral lobes, furnished with setae and a longish movable hook, and with the apposed margins deeply serrate and biserrate. This latter feature is of great importance, since we find it repeated in the following two families, *Corduliidae* and *Libellulidae*. The head is robust and armed with a projecting frontal plate, which it apparently employs for burrowing in sand; legs moderately long and not specialized for digging as in the *Gomphidae*; gizzard highly specialized, made up of 4 folds, each of which is furnished with a single robust tooth more or less spined on its free border. This type of gizzard is repeated in the same two families mentioned above, indicating the closest relationship between them and the *Cordulegasteridae*. The family contains two recent and one fossilerous subfamily.

Key to the subfamilies of the *Cordulegasteridae.*

Wings similar in the sexes, occasionally coloured at the base in the female; discoidal cells similar in shape and size in fore and hindwings; anal-loop rudimentary; tibiae without keels; ovipositor of great length. .. .. *Cordulegasterinae.*

Wings usually variable in the sexes and usually more or less coloured and with the base of hindwing greatly broadened in the female; discoidal cells of variable shape and size in fore and hindwings, especially in the female; anal-loop well developed; tibiae of male with keels; ovipositor short, inconspicuous. .. .. *Chlorogomphinae.*

Fossil species with rather broad wings and with extraordinary closely reticulated venation; discoidal cells differing in shape and size in fore and hindwings; ovipositor of great length as in the .. .. *Cordulegasterinae* .. *Aeshnidiinae.*

1. Subfamily CORDULEGASTERINAE. (Fig. 11.)

Forms belonging to this subfamily are distinguished by the great length of the ovipositor of the female, a condition due to hypertrophy of the terebra, the valves, which they conceal, being minute and rudimentary; the eyes are more widely separated than in the following subfamily; the discoidal cells are similar in the wings and elongated in the length of the wing and divided by a cross-vein; Rspl is well-defined in its basal part only, and Mspl is altogether absent, as also is the anal-loop; the pterostigma is narrow and usually elongate; the antenodal complex is similar to that of the *Gomphidae,* basal antenodals being absent; the median space is always free of veins. Abdomen cylindrical, somewhat dilated in the end segments, and always longer than the wings. Only in the females of the genus *Anotogaster* do we find any trace of colouring, although very adult females of *Neallogaster* may be more or less deeply infumated. The tibiae of the males are never keeled. Larvae as for the family.

Genera are: *Cordulegaster* Leach (Palaearctic, Nearctic, Oriental and one species from the Andes, S. America), *Anotogaster* Selys (Oriental, China and Japan), *Neallogaster* Cowley (Oriental). There are no Australian species.

2. Subfamily CHLOROGOMPHINAE.

There is only one genus in this family, which is distinguished by the short ovipositor of the female; the eyes are separated to a less degree than in the *Cordulegasterinae,* and, in the males, may be just in contact; the discoidal cells are dissimilar in the wings, that of the forewing similar to the *Cordulegasterine,* that of the hindwing elongate in the breadth of the wing, especially in the females, and divided into 3 or 4 cells; the antenodal complex is always reinforced by one or more accessory basal veins and the median space is traversed by one or more cross-veins; the anal-loop is usually highly developed and may consist of a great number of cells; Rspl and Mspl are generally absent. Abdomen cylindrical or rather compressed in the females, shorter or much longer than the wings. In the males, the apices are nearly always tipped with black, and in the females the whole wing may be tinted with amber or even opaque in parts. The tibiae of the males are invariably keeled, as in the following family, *Corduliidae.*

Genera are: *Chlorogomphus* Selys (Oriental and extending to Formosa, the Philippines and the Sondaic Islands). A second genus was erected by

Selys, *Orogomphus,* but it is doubtful if it can be separated from *Chlorogomphus* by any individual characters. There are no Australian species.

3. Subfamily AESHNIDIINAE. (Fig. 12.)

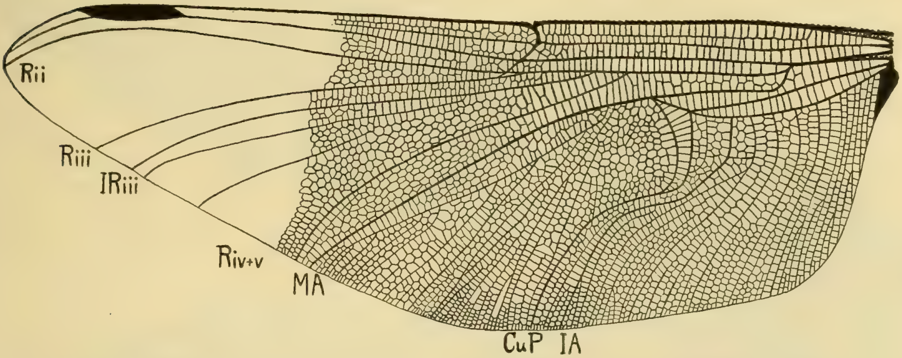


Fig. 12.—Wings of *Aeshnidiinae* (*Aeshnidiopsis flindersiensis* Wood).

This subfamily is erected to contain three fossil genera which are characterized by possessing a long ovipositor similar to that of the *Cordulegasterinae*; the eyes are more widely separated than in this subfamily and the discoidal cells vary in the wings as in the *Chlorogomphinae*. The wings are said to possess a subtrigone, but it is evident from its formation that it is not the same triangle common to the *Aeshnidae,* and, in most cases, is open posteriorly. The reticulation is very close in at least two of the genera; in the Australian form *Aeshnidiopsis* Tillyard, the venation is so close that there are two rows of cells between the costa and subcosta and a sector intercalated between these two main veins; only in the Australian genus *Telephlebia* do we find anything approaching such a condition. The three genera forming the subfamily have been placed in the *Aeshnidae* but because of the Cordulegasterine ovipositor, as well as the widely separated eyes, I have transferred them to the present family.

Genera are: *Aeshnidium* West., *Urogomphus* Handl., and *Aeshnidiopsis* Tillyard (Upper Jurassic and Cretaceous), the latter from Queensland Cretaceous. Tillyard (Biology of Dragonflies) states:—"The *Aeshnidiinae* seem to have died out in Cretaceous times; unless, indeed, the recent *Chlorogomphus* be a close ally or a descendant from them". I think that they are to be regarded as an annectant group between the two recent subfamilies of which they share the characters about evenly balanced. If so, then the *Chlorogomphinae* are the most recent forms in this complex, which may explain their comparative isolation within well-defined boundaries.

Superfamily LIBELLULOIDEA.

Generally, forms belonging to this superfamily are the most dominant and the most highly developed venationally of the whole order Odonata. The wings are hyaline, usually uncoloured, but in some genera are partly coloured and opaque; the hindwing is much broader at the base than the forewing and rounded or angulated in the male, always rounded in the female. Except in the most archaic forms, the antenodal complex has attained its completion, the primaries are absent or very poorly developed

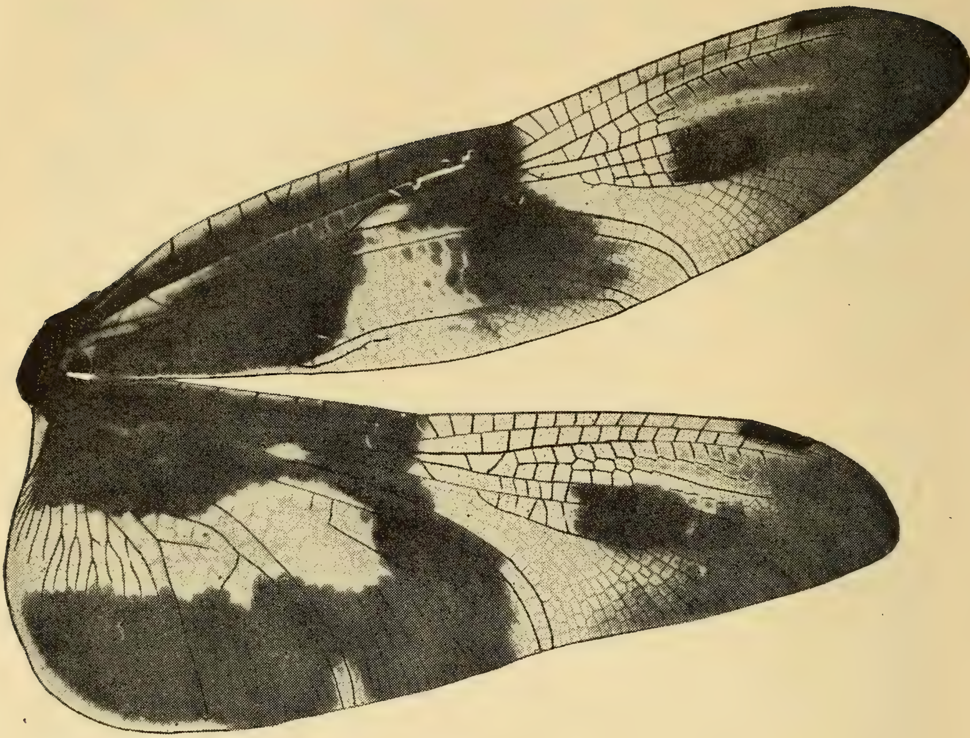


Fig. 13.—Wings of *Libellulidae* (*Rhyothemis regia regia* Brauer), male.

and the secondary costal and subcostal antenodals are all strictly aligned to one another. The discoidal cell varies in shape and position in the fore and hindwing; in the former it is always situated far distal to the level of the arculus, whilst in the latter it may lie distal or be recessed entirely to the level of the arculus; anal-loop absent or present, rudimentary or developed as a long, stocking-shaped formation in the base of the hindwing; Rspl and Mspl usually present, running parallel or concave to IRiii and MA respectively; pterostigma always present and of Lestine shape. Head globular, eyes rounded and either just meeting dorsally or broadly confluent; labrum with very small uncleft median lobe, largely overlapped by broad lateral lobes; thorax robust; abdomen of very variable shape, cylindrical or carinated, depressed or compressed, fusiform or tapering analwards, as long as, but usually shorter than the wings. Anal appendages of male of simple design, but more highly specialized and intricate in some genera. Female without a conspicuous ovipositor (except in a few aberrant species), both terebra and valves atrophied; oviposition accomplished by merely dipping the end of abdomen in water.

Larvae variable in the subfamilies but all alike in possessing a deeply cupped or spoon-shaped labium, the lateral lobes of which are either serrate in the archaic forms, or more or less deeply crenate along the inner border

in others; larval gizzard possessing 4 folds, each furnished with a single robust tooth. In these two characters, we find a strong connection between the *Libelluloidea* and the *Cordulegasteridae*.

Key to the families of the *Libelluloidea*.

Tibiae of males with a long, lamina-shaped keel on the flexor surface; base of hindwing in males strongly angulated (except in genera *Hemicordulia* and *Procordulia*); oreillets present on the sides of segment 2; body usually coloured metallic. . . . . *Corduliidae*.

Tibiae of males without keels; base of hindwing in both sexes rounded; oreillets absent on segment 2; body rarely coloured metallic. . . . . *Libellulidae*.

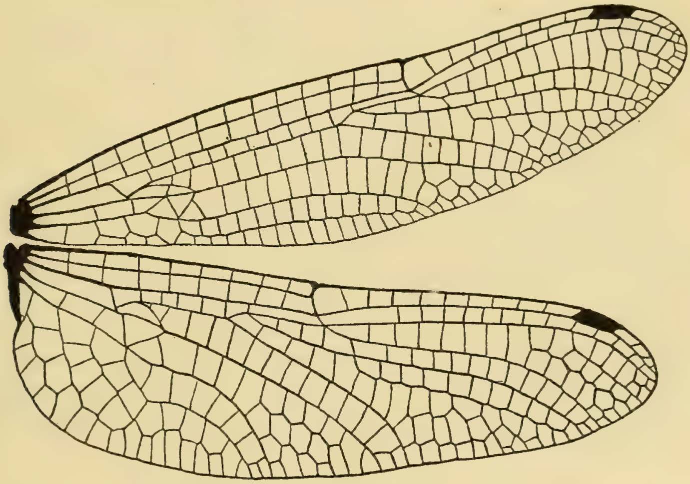


Fig. 14.—Wings of *Corduliidae* (*Idionyx saffronata* Fraser), male.

Family Corduliidae.

Dragonflies of large or medium size, with hyaline, uncoloured wings (very rarely coloured in part), angulated at the base in the males (except in genera *Hemicordulia* Selys and *Procordulia* Mart), nodus situated distal to middle of costa (very far so in *Idionyx*), pterostigma variable, usually rather short; anal-loop rarely absent, but vestigial in some genera and compact or elongated in others; antenodal complex graduating from an incomplete, Gomphine-like one in the archaic forms, to a complete or nearly complete one in the higher forms; the primaries, even in the higher forms, are still discernible although greatly atrophied; Rspl usually present but Mspl more often absent; anal triangle present in all males save those with rounded base to hindwings. Body colouring almost invariably partly or wholly metallic; abdomen cylindrical in the males or somewhat expanded analwards, usually compressed in the females. Larvae as variable as the imago; three types are known and are described below under the subfamilies.

Key to the subfamilies of the *Corduliidae*.

1. Discoidal cell with costal side broken in all wings; anal-loop absent; hindwing not markedly broader than the forewing. .. .. *Cordulephyinae*.
   Discoidal cell with costal side broken in all wings; anal-loop present, elongate; base of hindwing enormously expanded, much broader than forewing. .. .. *Neophyinae*.
   Discoidal cell with costal side straight, unbroken; anal-loop usually present, more or less well-defined. .. .. 2.

2. Anal-loop absent or rudimentary and with its midrib zigzagged between cells. .. .. *Gomphomacromiinae*.
   Anal-loop well-defined, its midrib, when present, running unbrokenly between cells or slightly zigzagged. .. .. 3.

3. Sectors of arculus fused for a long distance in all wings; anal-loop elongate, its midrib slightly zigzagged between cells; discoidal cell in hindwing incompletely recessed to arculus. .. .. *Idionychinae*.
   Sectors of arculus divaricate from origin in all wings; anal-loop elongate, its midrib not zigzagged between cells; discoidal cell completely recessed to arculus. .. .. *Corduliinae*.
   Sectors of arculus divaricate from origin in forewing, slightly fused in the hindwing; anal-loop compact, without midrib; discoidal cell in hindwing not recessed to arculus. .. .. .. 4.
   Sectors of arculus divaricate from origin in all wings; anal-loop elongate, its midrib not zigzagged; discoidal cell in hindwing not recessed. .. .. *Idomacromiinae*.

4. Anal-loop slightly longer than wide; median space never traversed by cross-veins. .. .. *Epophthalminae*.
   Anal-loop slightly wider than long; median space traversed by cross-veins. .. .. *Syntheminae*.

Subfamily CORDULEPHYINAE nov. subfam.

This subfamily is erected to hold a single genus *Cordulephya* Selys, which is confined to Australia. The four species belonging to the genus are all frail, graceful insects with rather large wings and long slender abdomen, and are of great interest from their habit of resting with their wings closely apposed over the dorsum as in the *Zygoptera*. The discoidal cells are of archaic shape, with costal side broken and therefore 4-sided cells; the anal-loop is absent and the base of the hindwing, in consequence, as narrow as that of the forewing. In spite of this archaic venation, the antenodal complex is complete, there being but the slightest differentiation between the primaries and secondaries; all triangles are entire; sectors of arculus divaricate from origin or slightly fused; discoidal cell in hindwing incompletely recessed; anal triangle small, entire. Male anal appendages simple, tapering, ventrally spined; female without ovipositor.

The larva is of the *Corduline* type, with large, quadrate head, small, beady, projecting eyes, thorax with a pair of robust spines on dorsum (as in *Oxygastra*), legs long and spidery, abdomen broadly oval. The labium, however, is unique and may be considered as an exaggeration of the most archaic Syntheminine type, with the serrations deepened to deep clefts on the inner border of the lateral lobe; it seems clear that it is a specia-

lization of this type. The gizzard has 4 folds, two furnished with a single tooth similar to those of the *Cordulegasterinae,* and two with duplicated apices.

This subfamily lies at the root of the *Corduliidae,* from where it has departed on an evolutionary line of its own. I doubt if we have yet solved the problem of these small, zygopterous-like forms of *Libelluloidea,* common to both the families. "Are we really dealing with archaic forms or has the venation undergone a secondary reduction?" The evidence seems to weigh strongly in favour of the latter.

Subfamily NEOPHYINAE nov. subfam.

This subfamily is again monogeneric and contains a single form from W. Africa characterized by the discoidal cells with costal side broken, and complete recession of the discoidal cell in the hindwing, as in the subfamily *Corduliinae.* The base of the hindwing is enormously dilated and contains a long, narrow anal-loop. The forewing might well belong to a *Cordulephya,* and the hindwing, apart from its dilatation, to a *Cordulia.* This combination of archaic and recent characters defies solution, and the place of the subfamily remains in doubt. Of the single genus *Neophya* Selys, only a single male specimen is known. Larva unknown.

Subfamily GOMPHOMACROMIINAE nov. subfam.

This subfamily contains a number of genera mostly confined to Australia, but two are found in S. America, and a single one in Madagascar, a southern distribution which is not without its significance when taken in conjunction with a similar distribution of the *Petaluridae* and the *Petalinae* of the *Aeshnidae.* They vary considerably in venation but, in all, the discoidal cell of hindwing is incompletely recessed, the triangles are all entire, the sectors of the arculus arise from a common point from which they immediately diverge, the anal-loop is either absent or rudimentary, and, although of some length in some genera (*Nesocordulia* and *Neocordulia*), its midrib zigzags between the cells.

Very few larvae belonging to this subfamily are known, but it may be said that they differ from those of *Cordulephya* by their smaller head, short stout legs, broader abdomen markedly flattened beneath; labium with deep, rather irregular incisions, armed with small spines but few setae.

Genera are: *Hesperocordulia* Till., *Austrocordulia* Till., *Austrophya* Till., *Lathrocordulia* Till., *Pseudocordulia* Till., *Syncordulia* Selys (all Australia), *Gomphomacromia* Brauer, *Neocordulia* Selys (S. America), and *Nesocordulia* MacLach. (Madagascar).

Subfamily SYMPETRINAE Tillyard.

This subfamily contains genera which are of the greatest phylogenetic importance since they not only show the evolution of the *Libellulidae* from the *Corduliidae,* but also establish the connection of the *Libelluloides* with the more archaic *Cordulegasteridae.* The venation in the lowest forms is transitional between the two families of the *Libelluloidea*; the antenodal complex of the genera *Synthemiopsis* and *Synthemis* is hardly better developed than in the *Gomphidae*; the primary antenodals are still strong and the secondaries are mostly out of alignment. By examining the older types of *Synthemis,* it is possible to form a series demonstrating the gradual atrophy of the primaries and the gradual alignment of the secondaries. This is preceded by a laying down of accessory basal antenodals, first in

the subcostal space, then in the costal, and finally these two new sets of antenodals come into alignment, at which stage the primaries become obsolescent. Accompanying this process, median cross-veins are found, but what their significance and function is is not quite clear; they apparently become obsolete in the higher forms, as they are altogether absent in the *Libellulidae.* The wings are hyaline and usually uncoloured; the discoidal cells entire, that of the hindwing incompletely recessed; the anal-loop is short and usually wider than long; the sectors of the arculus divergent from origin in the forewing, but slightly fused at origin in the hind; the median space is almost always traversed by one or two veins. The male anal appendages are variable, but usually rather long and sinuous; the female genitalia is transitional, short and atrophied valves in some species, but a long and conspicuous ovipositor in others, very similar to that of the *Cordulegasteridae.*

The larvae in this subfamily are rather variable, but in the lower forms show a remarkable likeness to those of the *Chlorogomphinae,* thus accentuating the affinities of this subfamily to the *Cordulegasteridae.* They are robust, hairy creatures with a frontal plate, cupped labium with deeply serrated borders and numerous setae; the antennae and the structure of the gizzard also conform closely to the larvae of the family mentioned, but the teeth on two of the folds have a bifid apex as in the whole of the superfamily *Libelluloidea.* Tillyard (Proc. Lin. Soc., N.S.W., 35:324, 1910) states: "This remarkable similarity between the larvae of *Synthemis* and *Cordulegaster* is of great phylogenetic importance, for it supplies the missing link between the two great divisions of the *Anisoptera*—the *Aeshnidae* and *Libellulidae*". It is more correct to say "between the *Cordulegasteridae* and *Libellulidae*", and to add that the venation of this genus also demonstrates how the *Libellulidae* have arisen from the *Corduliidae.*

Genera are: *Synthemiopsis* Till. (Tasmania), *Synthemis* Selys (Australia, Papua and New Caledonia), *Eusynthemis* Forst., and *Choristhemis* Till. (Australia).

Subfamily Idionychinae nov. subfam. (Fig. 14.)

Forms in this family are characterized by rather broad wings, large head and small, weak, thorax and slender abdomen. The males are unique in the family by their highly organized and intricate anal appendages; the females by a unique development of the vesicle, which may be conical, bifid or produced into fantastically shaped horns (but in a few species, the vesicle is normal). The wings are hyaline, and, in many females, broadly coloured at the base; discoidal cells entire, that of forewing small and equilateral, that of the hindwing twice as large and a little elongated and incompletely recessed to arculus; sectors of arculus fused for a long distance in fore and hindwings, more so than in any other genera in the family; antenodal complex complete; subtrigone absent; anal-loop a little elongated and with slightly zigzagged midrib; nodus lying far distal to middle of costa and the gap between the bridge and the level of the discoidal cell in the forewing is greater than in any other genus in the family; pterostigma very short; Rspl present, Mspl absent. The female is without an ovipositor and ova are deposited in mud or damp sand alongside streams. The larvae are of the Corduline type described under that family.

This subfamily bears the same relation to the *Corduliidae* as do the *Chlorogomphinae* to the *Cordulegasteridae,* both being tropical offshoots,

the larvae adapted to life in tropical torrential streams. The origin of the *Idionychinae* is doubtful, but I should say that they are an offshoot from the main Syntheminine stem. Their distribution extends from the Himalayas and Western Ghats of India to the Sondaic Islands and Borneo.

Genera are: *Idionyx* Selys, and *Idiophya* Fraser.

Subfamily IDOMACROMIINAE nov. subfam.

This subfamily is erected to hold a single aberrant genus whose strangely mingled characters do not permit of its inclusion within any of the other subfamilies belonging to the *Corduliidae*. The wings are broad, the hindwing broadly rounded at the base as in the *Libellulidae*; the reticulation is very close; antenodal complex complete and augmented by accessory basal antenodals and cross-veins in the median space as in genus *Synthemis*; the arculus is recessed to a degree not found in any other genus of the *Corduliidae* and lies at the level of the basal primary antenodal; the discoidal cell is elongate in the width of forewing, and in the length of hindwing, in which it is not recessed to the arculus; anal-loop very long and narrow, and its midrib runs straight between cells; Rspl and Mspl unusually well-developed. Male anal appendages resembling those of the *Epophthalmiinae*. Female unknown. Larva unknown.

There is only a single genus, *Idomacromia* Karsch (W. Africa), and this is known only from a single specimen. Its position in the *Corduliidae* is doubtful; the mixture of archaic and recent characters in its venation presents an insoluble problem. The position of the arculus, the high development of the anal-loop and the rounded base of the hindwing all suggest a recent development.

Subfamily EPOPHTHALMIINAE nov. subfam.

In this subfamily we find a very different type of dragonfly, most forms resembling in their robustness and size the Aeshnines rather than the Cordulines. The head is large and globular, the thorax massive, the legs long and spidery; the wings are long and rather pointed at apices; the base in the male strongly angulated and excised. Usually they are hyaline, but in some species there are opaque markings at the base and some patchy amber-tinted suffusion in the body or at the apices of the wings; the reticulation is close; discoidal cells entire or more rarely traversed, that of the hindwing in no way recessed; sectors of arculus fused for a short distance; antenodal complex complete; median space free; anal-loop compact, subquadrate and without midrib; subtrigone in forewing well-defined; anal triangle present; Rspl present, Mspl absent; pterostigma very short The anal appendages of male are simple, rather short, tapering and acuminate at apex and usually with a short lateral spine. Female without ovipositor; abdomen in the same sex markedly compressed.

Three types of larvae are known, but all agree in having a short, stoutly oval abdomen and usually long, spidery legs In the genus *Epophthalmia* the head is proportionately small to the body, subquadrate and with the eyes small and projecting upwards like those of a crab; the labium is one of the most formidable organs known in the order *Odonata*; it has a very long movable hook and is deeply fissured along the inner border to form a series of long-pointed teeth which, when meshed with those of the opposite side, remind one of a vermin-trap. In the Macromias, the head is larger, the eyes small and projecting more laterally; the abdomen is shorter, more rounded in outline and steeply carinated and

spined dorsally. The labium is typically Libelluline in formation, the movable hook small and the apposed borders of the lateral lobes deeply crenated. The Macromidias are very similar to the last but resemble more closely the larvae of the *Libellulidae*, and their legs are shorter, as in this family. Thus we have a series of larvae ranging from those which closely resemble the more advanced types of *Synthemis*, to the highly specialized ones of *Epophthalmia*. The larval gizzards are remarkably similar in all, to the Libelluline type. From the evidence of the larval characters, it must be assumed that this subfamily split off very early from the Cordulegasterine stem and probably as early as the most archaic types of the *Syntheminae*.

Genera are: *Epophthalmia* Burm. (Oriental and Japan), *Macromia* Rambur (Oriental, Japan and Nearctic: a single species is isolated in Australia and another in far western Europe, these being two of the most extraordinary cases of distribution within the order). *Macromidia* Martin (Oriental and Sondaic Islands), *Didymops* Rambur (N. America), *Phyllomacromia* Selys (Tropical Africa; several species of *Macromia* have been described from Africa, but an examination of their genitalia, which I carried out recently, proves them all to belong to *Phyllomacromia*).

Subfamily CORDULIINAE.

This, the largest subfamily of the *Corduliidae,* contains the Cordulines sens. strict., forms which are characterized by the sectors of arc divaricate from their origin, anal-loop nearly as long as in the *Libellulidae* and discoidal cell of hindwing recessed to about the level of the arculus or even slightly proximal to that structure. Generally they are robustly built insects with wings rather broadened at the base, which is either angulated, subrotundate or rounded as fully as in the *Libellulidae*. The reticulation is close; pterostigma moderately long and of Lestine shape; discoidal cells traversed or free, that of hindwing frequently split into 2 or 3 cells; Rspl usually well-defined, Mspl less often so; anal triangle present except in forms with rounded base to hindwing (*Hemicordulia*); arculus situated about midway between the two basal antenodals (but opposite the 2nd antenodal in *Antipodochlora*); antenodal complex complete. Abdomen cylindrical, constricted at segment 3, rather broadened at the end segments; male anal appendages variable, often highly specialized; female without ovipositor.

Larvae with head wider than deep, rounded in front and without frontal plate or horns; eyes small, directed forwards and outwards, thorax with two dorsal spines; abdomen longer than in the other subfamilies, gradually broadening analwards and obtuse at the end, spined dorsally; legs rather long in some, but generally considerably shorter than in other subfamilies.

The subfamily is cosmopolitan in distribution. Genera are: *Anacordulia* Till., *Antipodochlora* Fraser (Australasia), *Hemicordulia* Selys, *Procordulia* Mart. (Papua, Oceania and Australia; one species has also spread to India), *Cordulia* Leach, *Somatochlora* Selys, *Epitheca* Burm. (Nearctic and Palaearctic), *Tetragoneuria* Hagen, *Neurocordulia* Selys, *Platycordulia* Will., *Helocordulia* Need., *Epicordulia* Selys, and *Williamsonia* Davis (Nearctic), *Oxygastra* Selys (Palaearctic), *Aeshnosoma* Selys, *Paracordulia* Mart. (Neotropic), *Libellulosoma* Mart. (Madagascar). *Pentathemis* Karsch, is here treated as a synonym of *Aeshnosoma* Selys. Fossil genera: *Miocordulia* Kennedy (Miocene of N. America), *Cordulia* has also been reported from the Eocene and Miocene.

Family LIBELLULIDAE. (Figs. 3, 13 and 15.)

This enormous complex of forms, varying in size, shape and colouring, is the most dominant of all the *Odonata*. Their success has been due undoubtedly to the taking advantage of adventitious water supplies, and thus we find them, with very few exceptions, breeding in still waters, in strong contrast to the habitats of the *Corduliidae*, which nearly all breed in streams. Unlike this family, few species are coloured metallic, and it is perhaps more than a coincidence that it is these few which breed in running waters. They differ again from the *Corduliidae* by the rounded base of the hindwing in the males, and here, again, it may be more than a coincidence that those forms of the *Corduliidae*, which resemble the *Libellulidae* in this respect, breed in still waters. In other words, the metallic coloured *Libellulidae* and the rounded-winged *Corduliidae* almost certainly represent annectant forms bridging the two families; their morphology and ecology overlap.

Because of this habit of breeding in still waters, and because many such habitats are the creation of mankind, we find a great mass of the *Libellulidae* have forsaken the jungle for open and cultivated country. Moreover, the restricted nature of such habitats leads to overcrowding, a circumstance which leads to mass migration for which many species belonging to this family are notorious.

In addition to the characters noted above, the *Libellulidae* differ from all Cordulines by the absence of tibial keels, and also by the great development of the anal-loop, which acquires a more or less stocking-shape. The male anal appendages are very simple and homogeneous throughout the family; the females, except for a few aberrant species in the genera *Sympetrum* and *Uracis*, have no ovipositor.

The task of classifying this large complex has been carried out in a masterly manner by the late Dr. Ris (Cat. Coll. Selys, *Libellulines*, fasc. 9-16) and can hardly be improved upon. The Old and New World, supposedly parallel groups, are here merged into subfamilies because I believe that it is an actual relationship rather than a parallel development which we see; its occurrence throughout the order *Odonata*, and in every family of the order, is so frequent as to cast doubts on such a theory. Roughly, the family may be split up into three groups, a small archaic, corresponding to Group 1 of Ris, a transitional, corresponding to Groups 2, 4 and 5 of Ris, and a recent, which contains the remaining five groups. Group 3 of Ris appears to be an early, highly specialized offshoot from the transitional series. In the ten subfamilies detailed below more than a hundred genera have been described and, since no useful purpose would be served in giving the whole list, I content myself with mentioning those genera which occur in Australia, together with the more dominant ones which belong to each subfamily.

Subfamily 1. TETRATHEMINAE nov. subfam. (Fig. 15.)

Species belonging to this subfamily are usually of small size, frequently coloured metallic, marked with red or yellow; the wings are hyaline, rarely coloured, reticulation rather open; discoidal cell of forewing with costal side broken; sectors of arculus fused for a long distance; arculus situated distally between the 2nd and 3rd antenodal veins; Rspl of primitive build, Mspl absent; discoidal field beginning with a single row of cells; anal-loop absent or rudimentary; distal antenodal complete; accessory cross-veins to the bridge and extra cubito-anal veins frequently present. Most forms are found breeding in primaeval jungles in marshy spots beside streams.

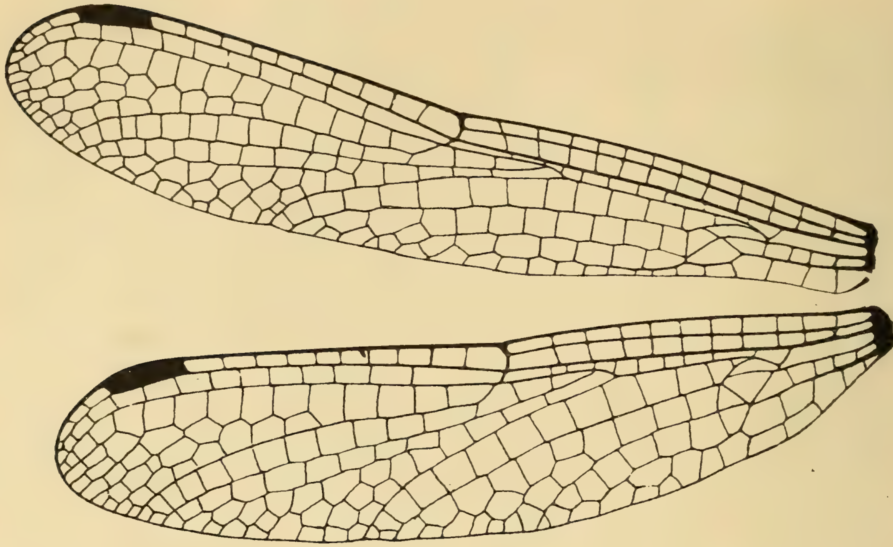


Fig. 15.—Wings of *Tetratheminae* (*Palaeothemis tillyardi* Fraser), male.

Genera are: *Tetrathemis* Selys (Oriental, Ethiopian and Australia), *Nannophlebia* Selys (Papuan and Australia), *Risiophlebia* Cowley, and *Palaeothemis* Fraser (Borneo and Burma respectively) are the smallest species, save *Nannophya*, known in the family, and have the hindwing of no greater breadth than the fore.

Subfamily 2. LIBELLULINAE.

Larger species than in the last subfamily and only occasionally coloured metallic; abdomen red, yellow or pruinosed bluish; wings hyaline, rarely coloured but occasionally marked at the apices and base; costal side of discoidal cell in forewing shorter than the distal or basal sides and very rarely broken sectors of arculus shortly fused (except in *Libellula*); arculus situated between the 2nd and 3rd antenodals; Rspl well-defined, Mspl absent or vestigial; discoidal field beginning with 2 or more rows of cells; anal-loop variable, usually well-developed; distal antenodal usually complete; accessory cross-veins to the bridge and cubito-anal veins often present. All the forms in this subfamily are still water breeders, although some may breed in sluggish streams.

Genera are: *Lathrecista* Kirby (Oriental, Oceania and Australia), *Amphithemis* Selys, *Lyriothemis* Brauer (Oriental and Papuan), *Orthetrum* Newman (Cosmopolitan, Australia), *Libellula* Lin. (Palaearctic and Nearctic).

Subfamily 3. DIASTATOPIDINAE nov. subfam.

This subfamily contains only four genera and is characterized by the relatively broad and dark-coloured wings; venational characters are similar to the last subfamily, but the arculus has moved proximally to between the 1st and 2nd antenodals. and in some of the genera the costal border of

forewing presents a curious sinuous hump near the base of wing. Species in this subfamily, mimic hymenopterous insects in their colour and flight, especially those belonging to genus *Palpopleura.*

Genera are: *Diastatops* Rambur, *Zenithoptera* Selys, and *Perithemis* Hagen (all Neotropical), *Palpopleura* Rambur (Oriental and Ethiopian).

Subfamily 4. Brachydiplacinae nov. subfam.

Two so-called parallel groups, belonging to the Old and New World respectively, make up this subfamily, which is characterized by a number of archaic or transitional formations in the venation; sectors of arculus fused at origin; the veins Riii, IRiii and Rspl all of primitive build; usually accessory cross-veins to the bridge and extra cubito-anal veins; discoidal cell of hindwing situated distal to the line of arculus; anal-loop variable but well-defined; arculus lying between the 1st and 2nd antenodals.

Genera are: *Nannophya* Rambur (Oriental and Australia), the smallest species in the family *Libellulidae*; *Uracis* Rambur (Neotropical), characterized by a secondary development of the ovipositor which resembles that of *Cordulegaster*; *Fylgia* Kirby (Neotropical), has the discoidal cell of forewing with costal side broken as in *Tetrathemis,* but its other venational characters are well advanced; *Oligoclada* Karsch, and *Microthyria* Kirby (Neotropical), both dominant genera.

Subfamily 5. Sympetrinae nov. subfam.

This subfamily contains species of moderate size and non-metallic colour. The wings are hyaline, coloured or not, reticulation close to very close (excessively so in genus *Neurothemis,* where the basic venation is reinforced by a dense network of smaller veins); arculus between the 1st and 2nd antenodals; sectors of arculus fused for a short distance at origin; Rspl and Mspl well-developed; anal-loop lengthened and stocking-shaped; anal field filled with rows of cells in the width of wing; archaic features such as accessories to the bridge, etc., absent.

Genera are: *Nannodiplax* Brauer, *Neurothemis* Brauer, and *Diplacodes* Kirby (all Oriental, Papuan and Australia, the latter genus also Ethiopian), *Crocothemis* Brauer (Oriental, Ethiopian and Australia), *Brachythemis* Brauer (Oriental and Ethiopian), *Sympetrum* Newman (Cosmopolitan, but not Australian), *Erythemis* Hagen, and *Erythrodiplax* Brauer (dominant in the Neotropics).

Subfamily 6. Leucorrhininae nov. subfam.

A small subfamily containing only four genera with venational details similar to the last but differing by the discoidal cell of forewing with a much longer costal side and the sectors of the arculus separated at origin as in the *Corduliinae.* Archaic characters such as accessory cross-veins to the bridge and extra cubito-anal veins are frequently present; the arculus is however recessed to between the 1st and 2nd antenodals. Species belonging to the group have the wings more or less brightly marked and coloured.

Genera are: *Leucorrhinia* Britt. (Palaearctic and Nearctic), *Celithemis* Hagen, *Planiplax* Muttkow., and *Brachymesia* Kirby (Nearctic and Neotropic; the former closely parallels the genus *Rhyothemis* in the colour and markings of its wings).

Subfamily 7. Tritheminae nov. subfam.

I include in this subfamily all those genera belonging to group 8 of Ris, but excluding *Onychothemis* and *Zygonyx.* Species are characterized

by a movement of the nodus distalwards or the apical portion of the wing is shortened; the anal-loop is highly developed and its outer angle extends well beyond the level of the discoidal cell; the anal vein bordering it outwardly is bent to a right angle; the venation is essentially recent and all archaic features have disappeared. Both size and colour vary widely and species may be entirely black or brightest red; the females are generally some colour approaching dull ochreous.

Genera are: *Austrothemis* Ris (the only representative in Australia), *Trithemis* Brauer (Oriental and Ethiopian), *Pseudothemis* Kirby (very large, robust species from Japan), etc.

Subfamily 8. Onychotheminae nov. subfam.

I include here two genera whose general facies and habits stand wide apart from the rest of the others in subfamily *Tritheminae*. Of these, *Zygonyx* Selys, so closely resembles the *Corduliidae* that it was at one time classed with them; the species, which are numerous and mainly Ethiopian, are generally steely-black, marked strikingly with yellow; the abdomen is long and narrow and bears an identification mark on segment 7, as in many Macromias. It is a riverine breeder and is usually to be seen patrolling or hovering in mid-stream. The other genus, *Onychothemis* Brauer, is also a riverine breeder and hawks swiftly up and down over a measured beat of its stream; it is of robust Libelluline shape, but is coloured green or coppery metallic marked with yellow as in many *Corduliidae*. The venation, in both, is similar to that of the *Tritheminae,* but the base of discoidal cell of hind-wing is usually slightly proximal to the level of the arculus.

Subfamily 9. Rhyotheminae nov. subfam. (Fig. 13.)

This is a monogeneric subfamily erected to hold a number of highly specialized forms characterized by their mimicry of *Rhopalocera* and *Hymenoptera*. Their wings are broad, rather short in some, and variable in shape in the sexes of others; heteromorphic females occur frequently in the latter group. The body, which is dark metallic, is never fully chitinized, apparently to reduce its weight. Thus the flight is fluttering or soaring, dependent more on the air currents than the insect's volition, and this together with the bright black and gold colouring of the wings, renders them remarkably like butterflies when in flight. Others have the bases of the wings dark metallic blue-black and, as this part only is visible during flight, they resemble very closely certain aculeates with which they associate. The venation is similar to that of the next subfamily with which Dr. Ris classed them, but the veins Riv + v and MA curve gently and evenly down to meet the border of the wing, instead of being strongly angulated towards the distal ends. The abdomen is very short and little more than half the length of the wings.

Genus: *Rhyothemis* Hagen (Oriental, Ethiopian and Australia).

Subfamily 10. Zyxommatinae nov. subfam.

This subfamily corresponds to the 10th or *Tramea* group of Ris and contains species usually of large size, with large head, small thorax and very long, pointed wings, broadened at the base of the hind. The nodus is situated far out; pterostigma very small and inconspicuous; sectors of arculus fused shortly or separated from origin; anal-loop very long, apical portion as long as or longer than basal and with outer angle rounded or acute; discoidal cell of forewing remarkably narrow in width of wing, its

apex directed strongly basalwards; Rspl and Mspl highly developed and concave to IRiii and MA respectively. The abdomen is narrow, cylindrical and somewhat constricted at segments 4 and 5; the male anal appendages are long and narrow. In the Trameas, venation may be said to reach perfection.

Genera are: *Zyxomma* Rambur (Oriental, Ethiopian and Australia), *Tholymis* Hagen (Circumtropical); these two latter genera are remarkable for having the apex of the anal-loop open. *Pantala* Hagen, and *Tramea* Hagen (Circumtropical and Australia), *Camacinia* Kirby, *Hydrobasileus* Kirby, *Macrodiplax* Brauer, and *Aethriamanta* Kirby (all Oriental, Papuan and Australian), *Urothemis* Brauer (Ethiopian, Oriental and Papuan).

In the preparation of this paper many hundreds of references have been made, and it is obviously impossible with the space at my command to give even a tenth of these. A number of relative ones have been given in the text and a few of the more important ones are listed here:—

GENERAL REFERENCES.

Palaeontology.

1931. Carpenter, *"Lower Permian Insects of Kansas"*, Proc. Amer. Jour. Sci. (5), 21:97.
1933. Carpenter, *"Lower Permian Insects of Kansas"*, Proc. Amer. Acad. Sci., 68:411.
1939. Carpenter, *"Lower Permian Insects of Kansas"*, Proc. Amer. Acad. Sci., 73:37.
1862. Hagen, *"Neurop. uns dem Lithographisches Schiefen in Bayern"*, "Palaeontographica", 10:105.
1866. Hagen, *"Neurop. uns dem Lithographisches Schiefen in Bayern"*, "Palaeontographica", 15:1-40.
1906-1908. Handlirsch, *"Die Fossilen Insekten"*.
1939. Handlirsch, *"Neue Untersuchungen uber die Fossilen Insekten"*.
1917. Lameere, "Bull. Mus. Nat. Hist., Paris, 23:141.
1925. Martynov, Rev. Russe Ent., 18:145.
1931. Martynov, Bull. Acad. Sci. U.R.S.S., 141.
1931. Martynov, Compt. Rendu. Acad. Sci. U.R.S.S., 46.
1932. Martynov, *"New Permian Palaeoptera and Some Problems on their Evolution"*, Trav. Inst. Palaeozool. Acad. Sci. U.R.S.S., 1:1.
1890. Scudder, "Tertiary Insects of N. America", U.S. Geog. Survey.
1916. Tillyard, *"Mesozoic Insects of Queensland"*, Queensland Geol. Survey, 2:27, 46, 50, 198 and 201.
1917. Tillyard, *"Biology of Dragonflies"*, 301.
1925. Tillyard, "Kansas Permian Insects", Amer. Jour. Sci., 9:328 and 10:41.
1925. Tillyard, *"British Liassic Dragonflies"*.
1937. Tillyard, "Kansas Permian Insects", Amer. Jour. Sci., 33:85.

Phylogeny and Systematics.

1925. Fraser, *"True position of* CHLOROGOMPHINAE", Rec. Ind. Mus., 27:423.
1929. Fraser, *"Revision Fissilabes"*, Mem. Ind. Mus., 9:69, 205.
1933-1936. Fraser, "Fauna British India" (Odonata), Vols. 1-3.
1937. Fraser, *"The Persistence of the Primary Antenodals in Odonata"*, Proc. R. ent. Soc. Lond. (A), 12:101.
1938. Fraser, *"Fallaciousness of the Theory of Pretracheation in Odonata"*, Proc. R. ent. Soc. Lond. (A), 13:60.
1939. Fraser, *"Function and Phylogenetic Importance of Basal Accessory Antenodals in Odonata"*, Proc. R. ent. Soc. Lond., 14:63.

1891. Karsch, *Syst. Aeschnines,* Ent. Nachr., 17:273.
1890. Kirby, Syn. Cat., Odonata.
1921. Laidlaw, *Syst. Aeschnidae,* Rec. Ind. Mus., 22:75.
1922. Laidlaw, *Syst. Gomphidae,* Rec. Ind. Mus., 24:367.
1923. Laidlaw, *Syst. Aeschnidae,* Proc. U.S. Nat. Mus., 62:11.
1906. Martin, Cat. Coll. Selys, *Cordulines,* 17.
1908-1909. Martin, Cat. Coll. Selys, *Aeschnines,* 18-20.
1901. Needham, *Gomphidae,* N.Y. St. Mus. Bull., 47:434.
1903. Needham, *"Genealogic Study Dragonfly Venation",* Proc. U.S. Nat. Mus., 26:703.
1910-1919. Ris, Cat. Coll. Selys, *Libellulines,* 9-16.
1850. Selys, *Rev. des Odonates.* 1853, *Syn. des Calopterygines.* 1854, *Syn. des Gomphines.* 1854, *Mon. Calopterygines.* 1858, *Mon. Gomphines.* 1859, *Add. Syn. Calopterygines.* 1859, *Add. Syn. Gomphines.* 1860-1865, *Syn. des Agrionines,* 1869, *2nd Add. Syn. Calopterygines,* 1869, *2nd Add. Syn. Gomphnes.* 1874, *Syn. Cordulines.* 1874, *Add. Syn. Cordulines.*
1871. Selys, *Classification Cordulines,* Ann. Soc. Ent. Belg. (C.R.), 4.
1910. Tillyard, *Mon. Synthemis,* Proc. Linn. Soc. N.S.W., 35:312; Id. Ibid., 36:381 and 388.
1917. Tillyard, *Biology of Dragonflies.*
1921. Tillyard, *Epiophlebia laidlawi* Till., Rec. Ind. Mus., 22:93.
1925. Tillyard, *Insects of Australia and New Zealand,* 65.
1928. Tillyard, *Evolution of Odonata,* Rec. Ind. Mus., 30:151.
1912. Walker, *N. American Aeschnines,* Toronto Stu. Univ. Biol., 11:1-213.
1907. Williamson, *Gomphinae,* Proc. U.S. Nat. Mus., 33:267. Id. Ibid. *N. American Macromias,* 37:369.

In addition to the above and other works by these authors, papers by the following have been referred to:—Asahina, Barnard, Bartenef, Borror, Brauer, Burmeister, Calvert, Campion, Cockerell (Palaeontology), Cowley (Synonymy), Forster, Gloyd, Gyger, Kennedy, Kruger, Lieftinck, Longfield, Lucas, MacLachlan, Montgomery, Morton, Rambur, Schmidt, Sjostedt, Strand, St. Quentin, Oguma and Valle. I am especially indebted to Mr. Cowley for his help in the synonymy and to Prof. Cockerell for the gift of papers and original figures.

ADDENDA ET CORRIGENDA TO PART II.

p. 199. The text-figures here and on p. 214 have been transposed.
p. 200. After *"D. apicalis* (Fraser)" on line 5 from bottom of page, read straight on to next para.
Line 3 from top of page, read "Agrioidea" for "Agriodea".
p. 202. In couplet 3 of Key, for ";" after "basal", substitute a hyphen.
p. 209. For *"Protophore"* on line 25, read *"Protothore"*.
p. 210. Add to list of genera at bottom of page the following:—"Fossil genera: *Zacallites* Cock. (Eocene), *Epallagites* Cock. (Eocene), *Euphaeopsis* Handl. (Jurassic), *Pseudoeuphaea* Handl. (Jurassic)."
p. 214. The text-figures here and on p. 199 have been transposed. On line 4 of legend, read for *"Ditaxineura", "Diphlebia"* On lines 14 and 8 from bottom of page, for "10" read "9".

ILLUSTRATIONS OF SOME AUSTRALIAN FISHES.

By G. P. WHITLEY.*

(Plates xxx.-xxxi. and text-figures.)

The crudest diagram of a fish reveals more of its character than the average description and facilitates identification of species. Thus the well-illustrated papers of Waite and McCulloch on Australian fishes were a tremendous advance on the pictureless pages of many of their predecessors. Though some hundreds of specimens have been well figured, many species still remain known only from old and often brief descriptions. I therefore propose to illustrate type specimens or authentic material of some of these less known species, and the drawings and photographs so collected will be embodied in my contemplated "Fishes of Australia" at a later date. In some cases, when suitable Australian specimens were not available, I have figured the species from adjacent waters. I have not repeated such references to literature as will be found in McCulloch's "Check-List" (Australian Museum Memoir, v., 1929).

Many worthless *nomina nuda* and substitute names of no validity are formally made synonyms of known species in this paper in order to purge the Australian list of numerous superfluous entries, and a few new names are propounded.

Family ELOPSIDAE.

Genus ELOPS Linné, 1766.

GULARUS, *subg. nov.*

Orthotype, *Elops australis* Regan, 1909.

The Australian species differs from the American genotype (*E. saurus* L.) sufficiently to be regarded as a new subgenus characterized as follows:—Lower jaw included, the premaxillary teeth being exposed when mouth is closed. Twelve to 15 gill-rakers on lower part of anterior gill-arch. About 31 branchiostegal rays. Less than 100 scales in a longitudinal series. Less than 70 vertebrae.

Elops hawaiensis Regan, 1909, also enters this new subgenus.

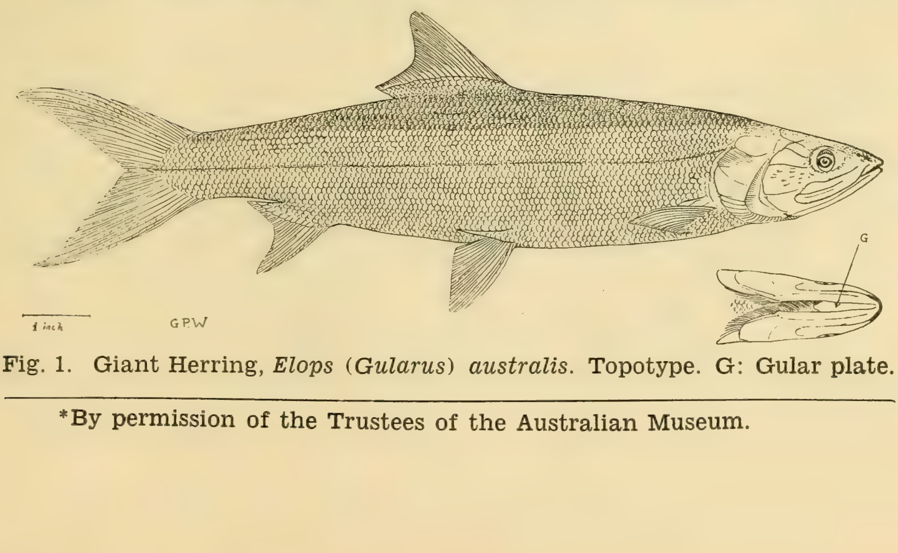


Fig. 1. Giant Herring, *Elops* (*Gularus*) *australis*. Topotype. G: Gular plate.

*By permission of the Trustees of the Australian Museum.

ELOPS (GULARUS) AUSTRALIS Regan, 1909.
(Fig. 1.)

The accompanying illustration shows a topotypical specimen (Austr. Mus., regd. No. I.4656), 330 mm. in total length, from Port Jackson, and thus the same length as Regan's type and from the same place, though differing from his description very slightly in some proportions.

D.6, 18; A.4, 11; V.2, 13. Sc. 94. L.tr., 14/1/14.

Family ALBULIDAE.
ALBULA NEOGUINAICA Cuv. & Val., 1846.
(Fig. 2.)

D.iii., 15; A.ii., 7; P.i., 18; V.i., 9. L.lat., 70 to hypural, plus a few more on tail. L.tr., 9/1/9. About 23 predorsal scales. General proportions as figured. Colour, in alcohol, silvery, without conspicuous dark stripes as in the Hawaiian *A. virgata*.

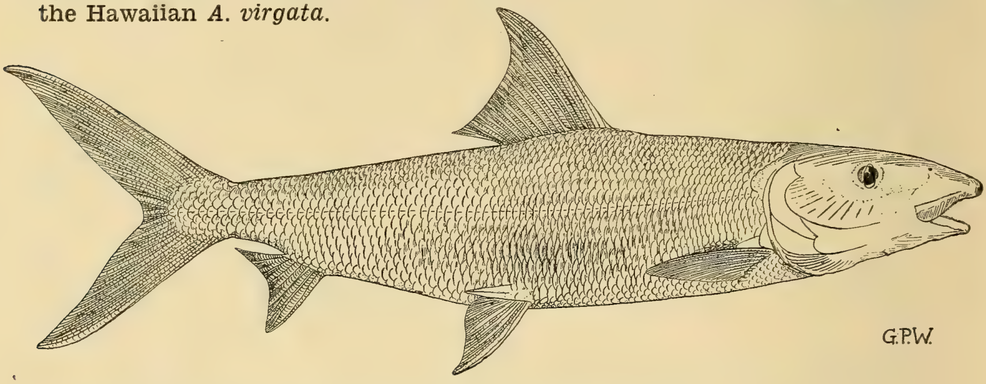


Fig. 2. Lady Fish, *Albula neoguinaica*.

Figured from a specimen 423 mm. in standard length or 20 inches overall.

Locality.—Netted in a lagoon, Ellice Islands, Oceania. Native name Kiokio. Presented by D. G. Kennedy. Austr. Mus., Regd. No. IA.5518.

The Australian Museum has another specimen from Lord Howe Island, from which place the species has not so far been recorded.

Family CHIROCENTRIDAE.
CHIROCENTRUS VORAX (Castelnau, 1873).
(Fig. 3.)

Neosudis vorax Castelnau, Proc. Zool. Acclim. Soc. Vict., ii., May 10, 1873, p. 118. New Caledonia.

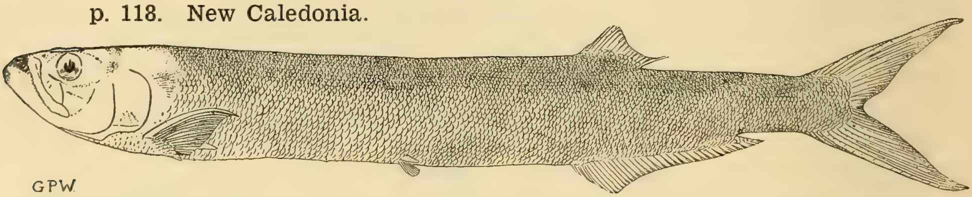


Fig. 3. Wolf Herring, *Chirocentrus vorax.*

Here illustrated from a 16 inch example from the Sir Edward Pellew Group, Gulf of Carpentaria, collected by the late Surgeon-Lieutenant W. E. J. Paradice (Austr. Mus., Regd. No. IA.1627). It has D.4, 13; A.4, 28; P.i., 13; V.i., 6.

Family Clupeidae.

Genus Clupeoides Bleeker, 1851.

Clupeoides papuensis (Ramsay & Ogilby, 1886).

(Fig. 4.)

Corica papuensis Ramsay & Ogilby, Proc. Linn. Soc. N.S.W. (2), i., May 25, 1886, p. 19.

Clupeoides papuensis Weber, Nova Guinea, ix., 1913, pp. 519 and 607.

Id. Weber and Beaufort, Fish Indo-Austr. Arch., ii., 1913, p. 60.

Id. Regan, Ann. Mag. Nat. Hist. (9), x., 1922, p. 588.

Id. Fowler, Mem. Bishop. Mus., x., 1928, p. 31; xi., 1931, p. 315; and xi., 1934, p. 386.

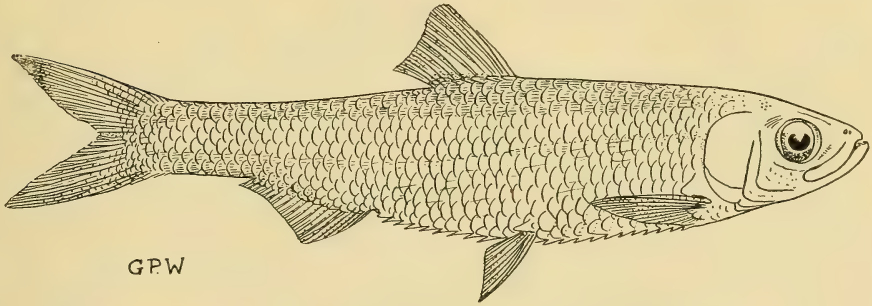


Fig. 4. Toothed River Herring, *Clupeoides papuensis*. Holotype.

Here figured for the first time from the holotype in the Australian Museum (No. B.9955), three inches in standard length.

D.i., 11; A.3, 17; V.7. Ventral scutes, 12 + 8.

Locality.—Strickland River, New Guinea (freshwater).

Not reported from Australia.

Fimbriclupea, *gen. nov.*

Orthotype, *Fimbriclupea dactylolepis*, sp. nov.

Mouth terminal. Maxillary broadly crescentic with supplemental bones. No ossified ligament. No symphysial notch. Operculum with only one upright groove. Cheeks venulose. Teeth wanting. Gill-rakers numerous, the upper ones not overlying the lower.

Habit similar to that of *Harengula* and *Sardinella* of authors.

Body with markedly fimbriate scales, with some of the transverse grooves not meeting at middle. About 40 transverse rows of scales. Belly cultrate. Scutes along ventral surface, no modified scales or scutes along back.

Dorsal fin without produced rays, its origin nearer snout than caudal fin. Anal fin short. Last two anal rays enlarged. Ventrals present, below the dorsal fin.

Includes *Clupea* (*Harengula*) *sundaica* and *gibbosa* Bleeker, the *"fimbriata"* of authors (*non* Cuv. & Val. and not *Clupea fimbriata* Bowdich).

Fimbriclupea dactylolepis, *sp. nov.*

(Fig. 5.)

D.3, 16; A.17 + 2; V.i., 7; C., 18. Sc. 41. Tr. 11. Fifteen predorsal scales and 16 + 12 abdominal scutes.

Head (25 mm.) nearly 4, depth of body (26), 3.8 in standard length (99). Eye, 7 mm.; interorbital, 5; snout, nearly 8; maxillary, 10; depth of caudal peduncle, 9 mm.

Head longer than high, slightly shorter than depth of body. Maxillary reaching to below front of eye. No symphysial incision. Jaws, palate and tongue edentulous. Sides of opercles densely venulose. One opercular groove anteriorly. More than 50 gill-rakers on lower limb of first branchial arch.

Form rather elongate, depth nearly 4 in standard length. Body-thickness less than 2½ in depth. Ventral profile more convex than dorsal profile.

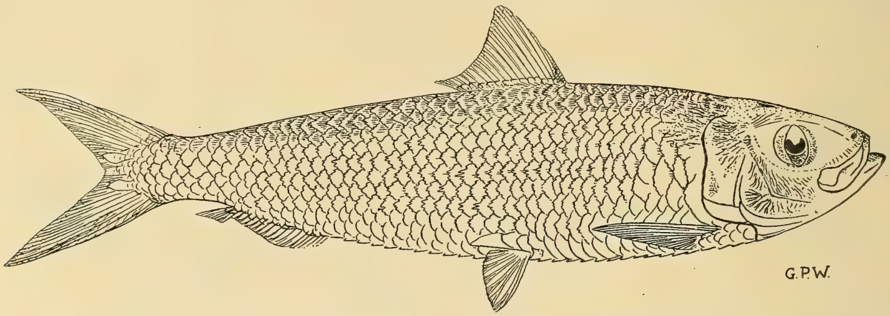


Fig. 5. Fringe-scaled Pilchard, *Fimbriclupea dactylolepis*. Holotype.

Body covered with large scales with the margins strongly fimbriate, especially at apex. Exposed surface of scale pitted or perforated. Distal transverse groove continued across scale, but three proximal grooves interrupted mesially. Belly compressed, scutes largely covered by flank-scales. No auxiliary scales. Enlarged caudal scales partly covered by smaller ones. Depth of caudal peduncle less than 3 in head.

Dorsal fin originating nearer snout than base of tail.

Anal fin with last two rays enlarged. Pectorals almost reach level of dorsal fin. Ventrals below front half of dorsal.

Colour, after long preservation in alcohol, dark bluish grey along back, without spots. Sides and belly silvery. Fins yellowish white. Bases of anterior dorsal rays notably dark brownish. Some infuscation of dorsal and caudal fins distally, but no conspicuous black tips to caudal.

Described and figured from the holotype, my largest specimen 99 mm. in standard length or five inches overall. Smaller paratypes are relatively deeper in body, the ventral profile being more strongly arched.

Locality.—Point Sampson, north-western Australia (Fisheries Department, Perth, 1914). Austr. Mus., Regd. No. I.13254.

This is the *Sardinella fasciata* of the Australian Check-List, not *Clupeonia fasciata* Cuv. & Val., 1847, from Bourbon, which has teeth on tongue and pterygoids. Also allied to the *Clupea* (*Harengula*) *sundaica* and *gibbosa* of Bleeker's "Atlas Ichthyologique" but differing in formulae.

FISCINA, *gen. nov.*

Orthotype, *Amblygaster posterus* Whitley.

This Western Australian pilchard differs from the genotypical *Amblygaster* (*clupeoides*) sufficiently to be separated under a distinct generic name.

Key:—

A. Maxillary reaching to below front margin of eye. 14 to 15 post-ventral abdominal scutes. 30 or more gill-rakers. Pectoral fin enlarged. Dorsal origin well forward. No scaly sheath to dorsal fin. Last two anal rays enlarged. .. .. *Fiscina,* gen. nov.

AA. Maxillary not nearly reaching eye-level. 12 post-ventral abdominal scutes. Less than 30 gill-rakers. Pectoral fin small. Dorsal origin about half way between tip of snout and root of caudal. A scaly sheath on dorsal fin. Last anal rays not differentiated from others. .. .. *Amblygaster.*

FISCINA POSTERA (Whitley, 1931).
(Fig. 6.)

Amblygaster posterus Whitley, Rec. Austr. Mus., xviii., 4, June 29, 1931, p. 144.

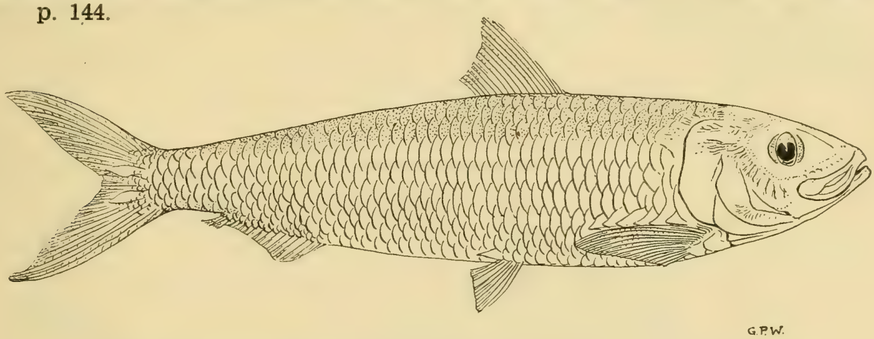


Fig. 6. Fremantle Pilchard, *Fiscina postera.* Holotype.

Here figured from the holotype of the species from Fremantle, Western Australia (Austr. Mus., Regd. No. I.12826).

SARDINOPS (FUSICLUPEA) DAKINI Whitley, 1937.
(Fig. 7.)

Sardinops dakini Whitley, Mem. Qld. Mus., xi., 1937, p. 114. Thursday Island, Queensland.

Here figured from a Murray Island example (Austr. Mus., No. I.11965), 183 mm. in standard length, which has D.3, 16; A.2, 15 + 2; P.18; V.i., 9.

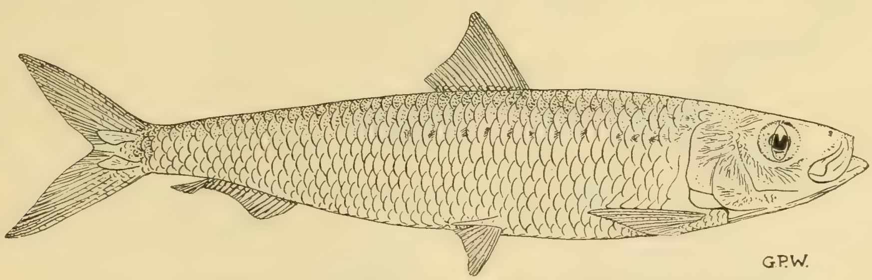


Fig. 7. Northern Pilchard, *Sardinops (Fusiclupea) dakini.*

Sc. 42. Tr. 11. Abdominal scutes, 17 + 12. Some teeth on palate but none on jaws. As there appear to be no auxiliary scales and the gill-rakers of the lower half of the first branchial arch are not overlain by the upper

ones, it is doubtful whether this species should be retained in *Sardinops*. It enters *Sardinella* as used by some authors, but the type of that genus is *aurita*, a very different Mediterranean species. From *Amblygaster*, it differs in having last anal rays enlarged. Under the circumstances, it seems best to propose the new subgeneric name *Fusiclupea*, with *Sardinops dakini* as orthotype.

ESCUALOSA, *gen. nov.*

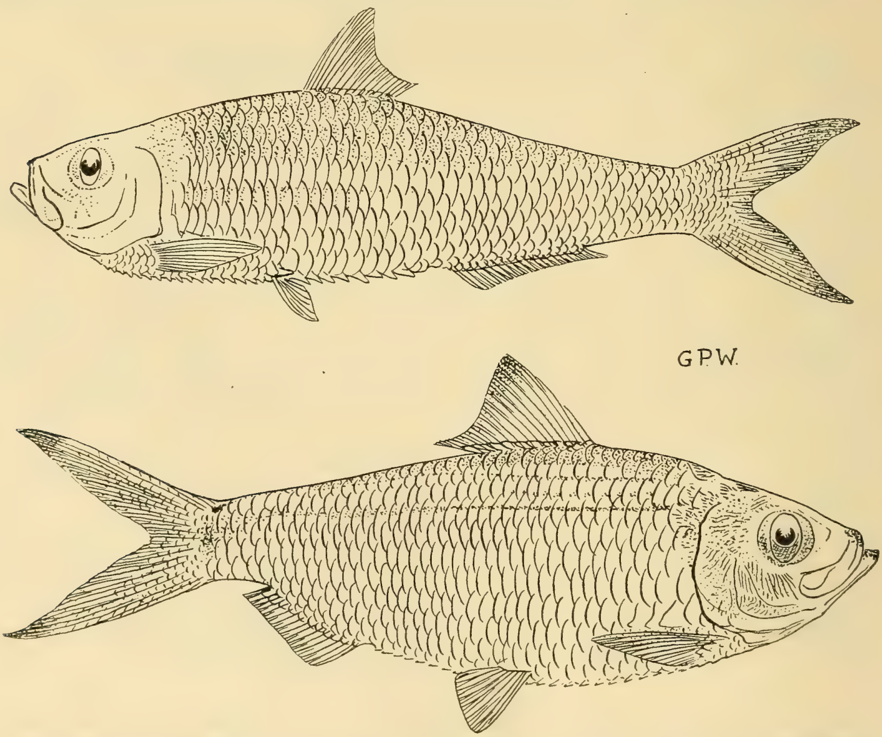
Orthotype, *Clupea macrolepis* Steindachner, 1879.

Maxillary reaching to below eye. Jaws subequal. Dentition obsolete or very little developed. Belly compressed, cultrate, with median scutes. Less than forty lateral scales. No auxiliaries. Transverse grooves on scales continuous. Dorsal fin normal, with about 17 rays, its origin nearer snout than root of caudal. Anal fin with 17 to 20 rays, the last not enlarged. Ventrals present, opposite or before level of dorsal origin.

Comes near the *"Clupea"* and *"Harengula"* of some authors' keys, but differs markedly in scale and fin-counts from the true genotypes of those genera.

ESCUALOSA MACROLEPIS (Steindachner, 1879).
(Figs. 8 & 9.)

I have seen and sketched the holotype of *Clupea macrolepis* in the Württembergische Naturaliensammlung, Stuttgart, Germany (No. 2292). It



Figs. 8 and 9. Deep Herring, *Escualosa macrolepis*. Upper figure (8), sketch of holotype of *Clupea macrolepis*; lower fig. (9), a Townsville specimen regarded as conspecific.

was evidently not a fully grown fish, being only 66 mm. in standard length or about 3¼ in. overall. Some of the scales were missing and I could only make out about 38 along the side and L.tr. 8 or 9; grooves extend across the middle of each scale. Nineteen preventral scutes plus eight large post-ventrals. No series of opercular grooves. Jaws toothless. A silvery lateral band. Caudal fin-tips black. For other characters, see Steindachner's description.

Locality.—Cleveland Bay, Queensland; Baron von Müller, 1877.

I identify as the same species some herrings collected at the same place (Townsville) by the late W. E. J. Paradice in 1924. These are Regd. Nos. IA.2331-2 in The Australian Museum and one (IA.2331) is here figured for comparison with my sketch of the holotype. It has D.ii/14-15; A.i/16-17. Head, 24 mm. Eye, 12. Depth of body, 32.5. Standard length, 91 mm. L.lat. circa, 36. The others show no important variation:—D.ii/14-15; A.ii., 18. Head, 26 and 24. Eye, 12 and 10. Depth, 35 and 31. Standard length, 99 and 86, and L.lat., 36 to 38. They differ from the type in having microscopic teeth in lower jaw, slightly deeper form and larger head, and ventral fins inserted slightly behind vertical of dorsal origin. These changes may be due to growth.

Family ENGRAULIDAE.

AMENTUM, *gen. nov.*

Orthotype, *Stolephorus commersoni* Lacépède, 1803.

Tropical Indo-Australian anchovies with the thorax compressed and bearing two to seven sharp-pointed scutes between pectoral and ventral fins. Maxillary not extending behind the gill-openings. Teeth small.

Anal fin below or behind level of middle of dorsal, or very little in front of same.

About 39 to 43 vertebrae.

Body translucent, with silvery lateral band. Scales thin, caducous.

This new genus is equivalent to *Stolephorus* Jordan and Seale (Bull. Mus. Comp. Zool., lxvii., 1926, p. 377) which is not *Stolephorus* Lacépède, *sensu stricto* (genotype, *Atherina japonica* Houttuyn, fixed by Jordan and Gilbert, 1882), the latter genus replacing *Spratelloides*.

AMENTUM CARPENTARIAE (De Vis, 1882).

(Fig. 10.)

Engraulis carpentariae De Vis, Proc. Linn. Soc. N.S. Wales, vii., October 28, 1882, p. 320. Norman River, Gulf of Carpentaria. Earlier as a nomen nudum in Southern Science Record for August, 1882.

D.i., 15 or ii., 14; A.ii., 21; P., 12; V., 7; C., 19. Six strong ventral scutes.

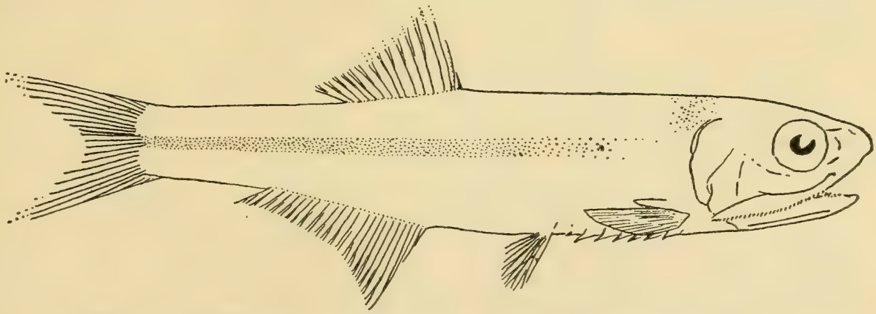


Fig. 10. Gulf Anchovy, *Amentum carpentariae*. Lectotype.

Maxillary produced to end of suboperculum, its teeth subequal. Snout shorter than eye.

Head (12 mm.) 3.8, depth before pectorals (9), 5.1 in standard length (46). Eye, 3.5 mm.; snout, 3; pectoral, 6.5 ?; base of anal, 10.5 mm.

Ventral fins nearer anal than base of pectorals. Anal originating before level of middle of dorsal fin.

Colour now faded, but described by De Vis as "Orange, with a rather broad, silvery streak. Head pale, silvery. A large dark spot on each side of occiput with a few black dots around it. Black dots along the spine and on each interneural joint of the dorsal and anal. Caudal punctated with black, others fine white, immaculate".

Described and figured from a cotype of De Vis' species, a little over 2 inches in total length. Some fin-tips and scales missing in my specimen. Colour faded, silvery lateral band present.

Locality.—"Cape York, Queensland," by exchange with the Queensland Museum in 1886. Austr. Mus., Regd. No. I.377, part. Doubtless one of De Vis' cotypes from the Norman River.

Stolephorus waitei Jordan and Seale, differs in proportions of head, anal fin, etc., but may be the adult of this species.

AMENTUM DEVISI, *sp. nov.*
(Fig. 11.)

D.ii., 13; A.ii., 18; P., 13; V., 7; C., 19. Five ventral scutes.

Maxillary produced to a little beyond preopercular ridge, provided with several enlarged recurved teeth among the others distally.

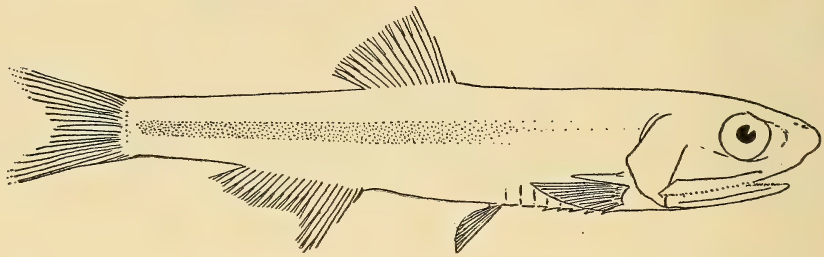


Fig. 11. De Vis' Anchovy, *Amentum devisi.* Holotype. Enlarged to same scale as figure 10.

Snout as long as eye, considerably overhanging mandible.

Head (12), 3.6; depth before pectorals (7.75), 5.6 in standard length (44). Eye, 3.25 mm.; snout, 3.25; pectoral, 6.25; ventral, 4; base of anal, 8 mm.

Ventral fins midway between pectoral base and anal. Anal fin originating below termination of dorsal fin.

Described and figured from a "Cape York" specimen, 2 inches long, mixed with *carpentariae* De Vis, and from the same source. Austr. Mus., Regd. No. I.377, part.

Family STERNOPTYCHIDAE.

ARGYROPELECUS (STERNOPTYCHIDES) AMABILIS (Ogilby, 1888).
(Fig. 12.)

Sternoptychides amabilis Ogilby, Proc. Linn. Soc. N.S. Wales (2), iii., 1888, p. 1313. Lord Howe Island. Type figured by McCulloch, Rec. Austr. Mus., xiv., 1923, p. 118, pl. xiv., fig. 3.

Specimens recently obtained in New South Wales waters by the C.S.I.R. investigators with the "Warreen" (Station 104/38.N.200) constitute a new record for Australia proper. These specimens differ somewhat from the Lord Howe Island type and from the New Zealand *intermedius* Clarke (Trans. N. Zeal. Inst., x., May, 1878, p. 244, pl. vi., Hokitika), notably in having two well-developed pubic spines, differently shaped dorsal stripe, shape of ventral profile and in having a reticulated area in gill-slit.

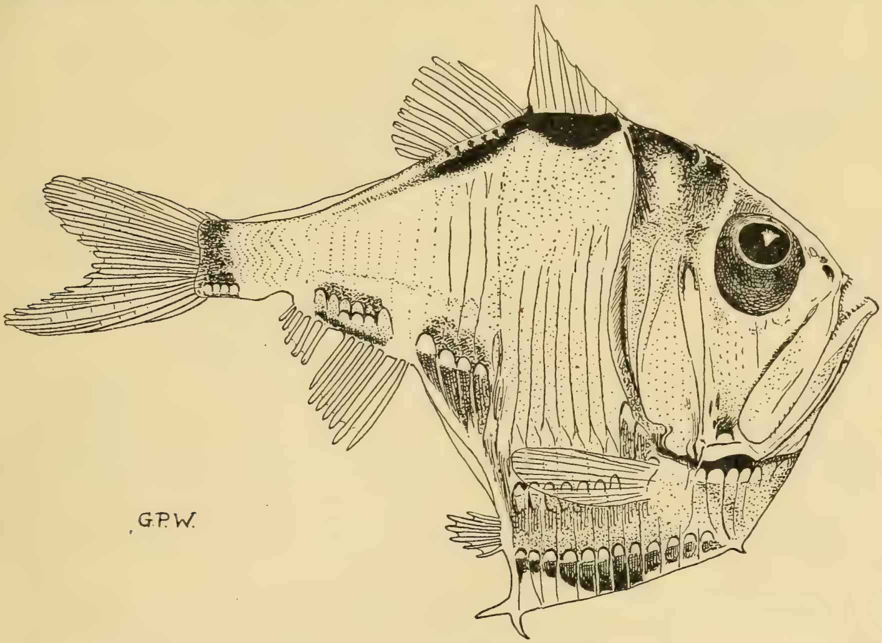


Fig. 12. Hatchet Fish, *Argyropelecus* (*Sternoptychides*) *amabilis*. Immature.

Here figured from a specimen (Austr. Mus., Regd. No. IA.8024), 22 mm. in standard length. It has D., 9; A., 7/5; P., 9; V.i., 5, and photophores 12 + 4 + 6 + 4.

Locality.—About 20 miles east of Port Hacking, N.S. Wales; netted.

Family PRISTIGASTERIDAE.
Genus NEOSTEUS Norman, 1923.
NEOSTEUS SCHLEGELII (Castelnau, 1873).
(Fig. 13.)

Meletta schlegelii Cast.; *Clupea schlegelii* and *Neosteus ditchela* of Australian lists.

Castelnau's species has not been recognized since first described, but a 6 inch specimen of "*Neosteus ditchela*" from the Sir Edward Pellew Group, Gulf of Carpentaria, in the Australian Museum (IA.2555) appears to be conspecific and is figured here. The large number of anal rays, reduced ventral fins, and prominent lower jaw are characteristic. The specimen agrees well with Castelnau's description, except that the origin of its ventral fin lies approximately below that of the dorsal and the tip of the pectoral

fin; the head goes about 3½ instead of 4 in standard length and there are 35 anal rays instead of about 29, but it may be that Castelnau had no microscope to aid him in counting or he may have had a dried specimen. The presence of a toothed bone between the intermaxillary and maxillary shows that my specimen is a *Neosteus*. It also has the following characters: D., 4/14; A., 3/35; P., 2/17; V., 7; C., 15; Sc., *circa* 34 (some missing in specimen); L.tr., 12; about 7 predorsal scales, 19 plus 9 abdominal scutes and at least 22 gill-rakers below. Fine striae on suborbital and operculum.

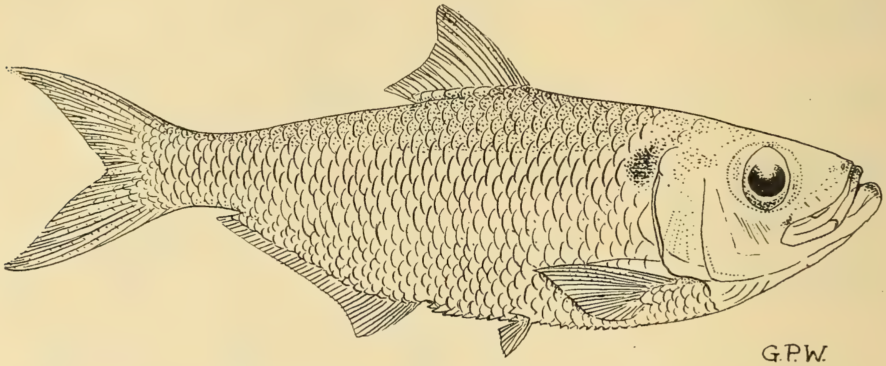


Fig. 13. Ditchelee, *Neosteus schlegelii*.

Fine teeth in jaws, along palatines and edge of maxillae. A dark humeral blotch. A copepod parasite on roof of mouth and a large isopod in gill-slit.

Our *schlegelii* differs from the Indian *N. ditchela* in having snout shorter than eye-diameter, fewer anal rays, fewer and larger scales.

Family CHANIDAE.

CHANOS SALMONEUS (Bloch & Schneider, 1801).

(Fig. 14.)

Here illustrated from a small specimen, 215 mm. in standard length, from Bedwell Point, Northern Territory; Mr. Melbourne Ward (Austr. Mus., Regd. No. IA.7681), caught in June, 1938. The small, broad, horseshoe-

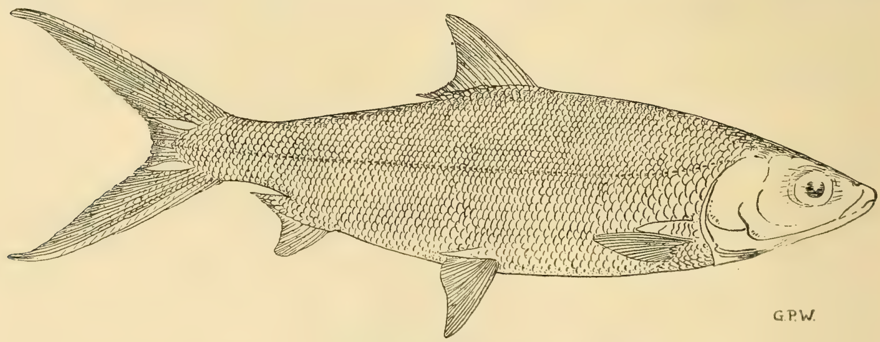


Fig. 14. Milk Fish, *Chanos salmoneus*.

shaped mouth has no teeth. D.2, 12 (last thick); A.2, 10; P.2, 16; V.i., 12; L.lat., 91. L.tr., 12/1/13. Predorsal scales 27.

Family Alepocephalidae.

Rouleina eucla, *sp. nov.*

Aleposomus (*Rouleina*) *squamilaterus* McCulloch, Biol. Res. Endeavour, v., 4, June 8, 1926, p. 163, pl. xliv., fig. 1. Not *Xenodermichthys squamilaterus* Alcock, 1898, from off the Andaman Islands.

A geographical species whose numerical features do not agree with the typical *squamilaterus* of Alcock.

Proditor, *gen. nov.*

Orthotype, *Alepocephalus andersoni* Fowler (Proc. Acad. Nat. Sci. Philad., lxxxv., 1933, p. 246, fig. 8) from the Philippines.

I take this opportunity of supplying a new generic name to replace *Normania* Parr (Bull. Bingham Oceanogr. Coll., iii., 7, August, 1937, p. 9), twice preoccupied. *Proditor andersoni* is extra-Australian.

Family Gonostomatidae.

Narooma benefica Whitley, 1935.

(Fig. 15.)

Narooma benefica Whitley, Rec. Austr. Mus., xix., 4, September 19, 1935, p. 215. Narooma, N.S.W.

Here figured from the holotype.

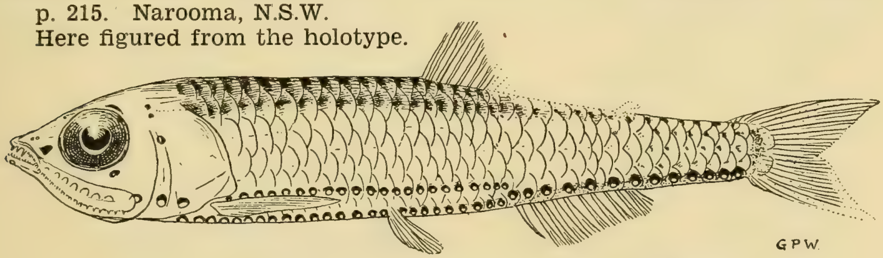


Fig. 15. Lantern Fish, *Narooma benefica*. Holotype.

Narooma benefica is allied to the genera *Poweria* Bonaparte, 1840 (*Vinciguerria* of authors and of Norman's recent revision, Discov. Rept., ii., 1930, p. 290) and *Zalarges* Jordan & Starks, 1896.

My species has a pair of small photophores at the mandibular symphysis. Scales about 29.

Family Plotosidae.

Paraplotosus albilabris (Cuv. & Val., 1840).

Plotosus albilabris Cuvier & Valenciennes, Hist. Nat. Poiss., xv., 1840, p. 427; ed. 2, p. 316. Batavia.

Plotosus microceps Richardson, Zool. Voy. Erebus and Terror, Fish, 1845, p. 31, pl. xxi., figs. 4-7. N.W. coast of Australia.

Copidoglanis longifilis Macleay, Proc. Linn. Soc. N.S. Wales, vi., 2, September 12, 1881, p. 207. Long Island, Torres Strait.

Plotosus laticeps, Copidoglanis labiosus and *labrosus, C. levis,* and *C. curtus* Saville-Kent, Prelim. Rept. Food-Fish. Qld., 1889, p. 10; Great Barrier Reef, 1893, pp. 298 and 370. Queensland. *Nomina nuda.*

A common catfish from Queensland (where I have collected it at Lindeman Island), around north Australia to Western Australia, south to Fremantle. On comparing Port Darwin examples with Richardson's *Plotosus microceps*, I am of the opinion that that species is a synonym of *albilabris*. Ogilby's genus *Endorrhis* becomes a synonym of *Paraplotosus* Bleeker. Saville-Kent's troublesome *nomina nuda* may be formally disposed of by also being relegated to this synonymy.

In fact it may be as well to dispose of all Saville-Kent's *nomina nuda* here to avoid further trouble. For references, see Austr. Mus. Mem., v., 1929.

Clupea profundis, torresiensis and *ranelayi*	= *Harengula punctata stereolepis.*
Plotosus laticeps	= *Paraplotosus albilabris.*
Copidoglanis labrosus and *labiosus*	= *Paraplotosus albilabris.*
Copidoglanis levis and *laevis*	= *Paraplotosus albilabris.*
Copidoglanis curtus	= *Paraplotosus albilabris.*
Belone staigeri, tyrannus and *vorax*	= *Lhotskia macleayana.*
Sphyraena dentatus = *S. strenua*	= *S. obtusata.*
Caranx filigera	= *Citula oblongus auriga.*
Chorinemus maculosus	= *Scomberoides lysan*
Pomatomus tubulus	= *P. pedica.*
Equula spiniceps	= *Equula decora.*
Dules produles	= *Herops munda.*
Serranus armatus	= *Epinephelides armatus.*
Serranus rubriniger	= *Epinephelus corallicola.*
Serranus subniger	= *Epinephelus corallicola.*
Mesoprion aurivittatus	= *Glabrilutjanus marshalli** = juv. of *Paradicichthys venenatus* Whitley, 1930.
Mesoprion helenae	= *Glabrilutjanus marshalli** = juv. of *Paradicichthys venenatus* Whitley, 1930.
Diagramma amabile	= *Plectorhinchus roughleyi.*
Diagramme amicium	= *Plectorhinchus roughleyi.*
Pristipoma nigrorubrum	= *Pomadasys hasta.*
Pristipoma variegatum	= *Pomadasys hasta.*
Therapon carbo	= *T. carbo* McCulloch and Ogilby, 1916.
Therapon ater	= *T. carbo.*
Therapon cavifrons	= *T. carbo.*
Therapon maculosus	= *T. unicolor.*
Lethrinus flavescens, lacrymans, margaritifer, regius, and *viridis*	= *Lethrinus viridis* Whitley.
Scatophagus brunneus	= *Selenotoca aetatevarians.*
Scatophagus chameleon	= *Selenotoca aetatevarians.*
Scatophagus semistrigatus [*semistrigigena* Innes]	= *Selenotoca aetatevarians.*
Teuthis mixtus	= *Amphacanthus nebulosus.*
Teuthis vitticauda	= *Amphacanthus nebulosus.*
Neorhombus ocellatus	= *Pseudorhombus arsius.*

*Mr. T. C. Marshall, of the Queensland Museum, has discovered by examining many specimens that "*Lutjanus nematophorus*" or *Glabrilutjanus marshalli* Whitley (Rec. Austr. Mus., xviii., 1932, p. 338) is the young of the Chinaman Fish, *Paradicichthys venenatus* Whitley (Mem. Qld. Mus., x., 1930, p. 13, pl. i., fig. 1), the long fin-rays of the young break off as it becomes adult. Thus *Glabrilutjanus* Fowler (Bull. U.S. Nat. Mus., 100, xi., 1931, p. 88) = *Paradicichthys.*

Ammotretis ovalis	= *Ammotretis rostratus.*
Synaptura armata	= *Synaptura nigra.*
Synaptura inermis	= *Synaptura nigra.*
Paraplagusia brevirostris	= *P. unicolor.*
Neoodax nebulosus	= *Olisthops cyanomelas.*

Family TACHYSURIDAE.

Genus TACHYSURUS Lacépède, 1803.

PARARIUS, *subg. nov.*

Orthotype, *Arius proximus* Ogilby, as identified and figured below.

Also includes *Arius graeffei* Kner and Steindachner.

Casque weakly granular, mostly concealed by skin. Fontanelle lanceolate. Eyes with margins free, situated behind level of mouth. Two pairs of nostrils, the posterior with large flap. Villiform teeth on jaws and palate, the latter not extending backwards as in *Netuma*. Six barbels. Gill-membranes united across isthmus. Interdorsal space greater than length of head. Adipose dorsal fin small, over posterior part of anal base (in typical *Tachysurus* it is described as being similar in size and form to the anal). Anal margin concave (not convex as in *Hexanematichthys*), the fin having fifteen rays (instead of about 20 as in *Pimelodus arius,* the tautotype of *Arius* Cuv. & Val.).

TACHYSURUS (PARARIUS) PROXIMUS (Ogilby).
(Fig. 16.)

? *Arius graeffei* Kner & Steindachner, Sitzungsb. Ak. Wiss. Wien., liv., 1866 (1867), p. 383, fig. 12. "Samoa".

Arius proximus Ogilby, Proc. Linn. Soc. N.S. Wales, xxiii., December, 1898, p. 280. Port Darwin.

Arius (*Tachysurus*) *graeffei* Paradice & Whitley, Mem. Qld. Mus., ix., 1927, pp. 80 and 97. Sir Edward Pellew Group.

D.i/7; A., 15; P.i.. 10; V., 6; C., 15.

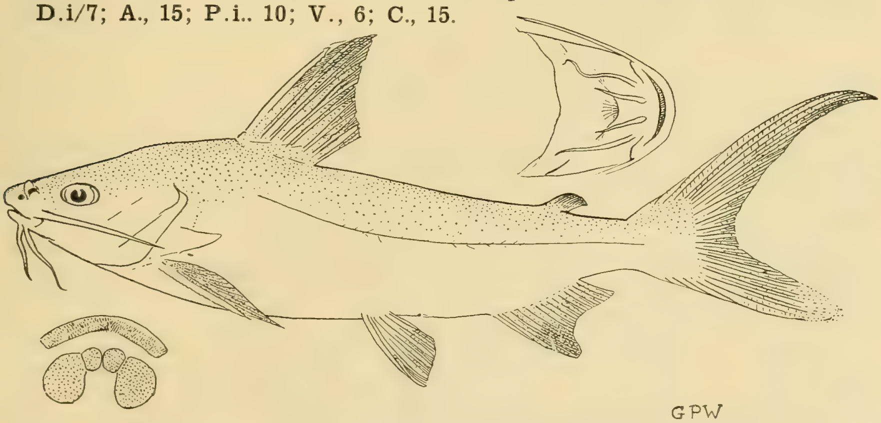


Fig. 16. Sea Catfish, *Tachysurus* (*Pararius*) *proximus.* Teeth from a second specimen.

Head (55 mm.) 4, depth (49) 4½ in length to end of middle caudal rays (225). Width of head (42) subequal to its height. Eye, 11.5 mm.; interorbital, 29; snout, 16; width of mouth-opening, 25; maxillary barbel, 39; mandibulary barbel, 28; mental barbel, 20; predorsal length, 75; interdorsal, 70; pectoral spine, 36; depth of caudal peduncle, 15.

Eye with free lid. Interorbital broad and flat. Mouth well before level of eye. Premaxillary teeth in a continuous band, emarginate posteriorly and obliquely truncate at extremities. Mandibular band divided, tapering from symphysis backwards, vomerine and palatine teeth villiform, well-developed, deciduous, in continguous patches as figured.

Maxillary barbel reaching gill-opening at opercular flap.

Mandibulary barbel reaching gill-opening at isthmus; mental barbels short. Gill-membranes united across isthmus at oblique angle.

Cranial and nuchal shields with few rounded granules nearly all of which are concealed by the smooth skin on top of head. Predorsal shield small, hidden. Fontanelle inconspicuous, longer than eye, tapering posteriorly; occipital groove deep and long. Opercles smooth.

Lateral line obsolete below middle of dorsal fin and without anterior granulation. A small axillary slit. Predorsal length about one-third length to end of middle caudal rays.

Dorsal spine granular in front, weakly serrated behind, equal in length to maxillary barbel. Adipose fin moderate, much longer than high. Anal length subequal to its height, about half head. Ventrals truncate, equal to interorbital, and not reaching anal. Pectoral spine more strongly serrate than dorsal. Upper caudal lobe (longest ray, 67 mm.) longer than head. No produced fin-rays.

Iridescent blue-grey on back, silver on belly. Pupil black.

Iris coppery. Fins greyish; adipose dorsal darker.

Described and figured from a small specimen (Austr. Mus., Regd. No. I.13211), nearly 11 inches overall, from Broome.

New record for Western Australia.

During my stay at Broome in July, 1939, I found this catfish common on the mudflats near the jetty. The specimen described above has been in the Australian Museum for some years.

Details of dentition, cranial shields and fontanelle from a skull of another Broome specimen.

Family OPHICHTHYIDAE.

YIRRKALA, *gen. nov.*

Orthotype, *Y. chaselingi*, sp. nov.

A genus of very elongate eels with tail-tip bare, gill-slits approximate and ventrad, with jugostegalia developed. More than one row of vomerine teeth. Dorsal fin low, originating just behind head. Anus about half-way along fish. No pectoral or caudal fins. Coloration uniform.

Apparently allied to the Indian *Sphagebranchus* and Mediterranean *Caecula*, but differing in having dorsal and anal fins present. *Dalophis* is a Mediterranean genus only superficially similar. *Anguisurus* and *Lamnostoma* have white ornamentation on nape.

Besides the genotype, this new genus may include *Dalophis anceps* Cantor (Journ. Asiatic Soc. Bengal, xviii., 1849, p. 1309; Cat. Malay. Fish., 1850, p. 327, pl. vi., figs. 1-4) = *Yirrkala anceps*, from Penang. Also *Sphagebranchus lumbricoides* Bleeker (Ned. Tijdschr. Dierk., ii., 1864, p. 46) = *Yirrkala lumbricoides*, from Timor.

YIRRKALA CHASELINGI, *sp. nov.*

(Fig. 17.)

Head (32 mm.) nearly 19 in total length (c. 607 mm.) or about 10 in preanal length. Interorbital (2.5) 2 in the acutely pointed snout (5). Lower jaw much shorter than upper and with slight ascending ramus. Acute fangs on jaws and palate, and in more than one row along part of

vomer. Gape about one-third of head. Anterior nostrils in short tubes, posterior ones large and opening downwards along upper lip. Eye small, adnate to sides of head. Several pores around eyes and chin. No barbels. Gill-openings low, latero-ventral, behind the twenty or so jugostegalia which reach behind the head.

Body very elongate, its depth about 76 in total length, broadest anteriorly, not swollen towards end of tail, and subcylindrical. Skin smooth, overlying the continuous lateral line. Vent large, just before middle of fish. Dorsal fin low, commencing just behind top of head; anal similar, originating about half-way along fish; both fins of many short rays, ending before the free hard-pointed tail-tip. No pectoral, ventral, or caudal fins.

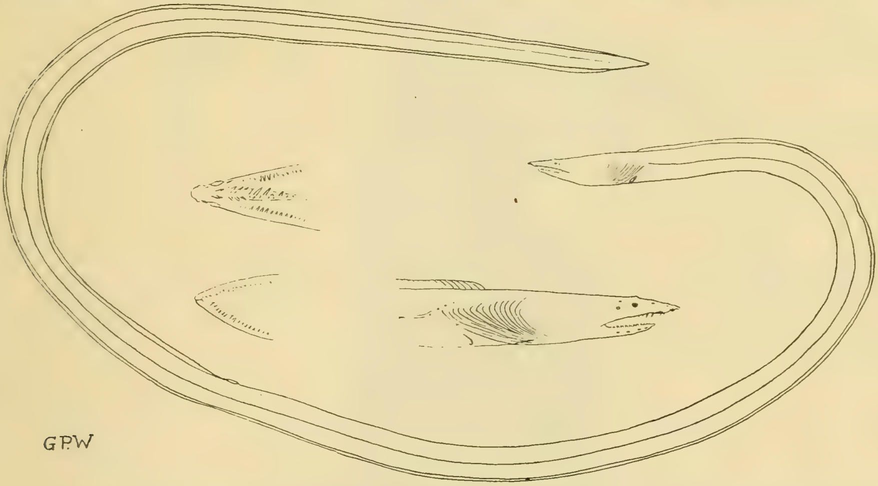


Fig. 17. Chingilt, *Yirrkala chaselingi*. Holotype.

Colour, in alcohol, fairly uniform reddish brown. Lateral line yellow. Tip of snout blackish.

This species differs from *anceps* and *lumbricoides* in position of dorsal origin, proportion of head to trunk, in having vomerine teeth largest, and other details of proportions and dentition.

Described and figured from the holotype, the largest of three specimens up to about 607 mm. or two feet long. Austr. Mus., Regd. No. IB.481.

Locality.—Yirrkala, near Caledon Bay, western shore of the Gulf of Carpentaria, Northern Territory of Australia; presented by the Rev. W. S. Chaseling, in whose honour this novel species is named.

Family Alepisauridae.

Alepisaurus richardsonii Bleeker, 1855.

(Fig. 18.)

Alepisaurus richardsonii Bleeker, Verh. K. Akad. Wetensch. Amst., ii., 1855, pp. 2 and 10. Based on *Alepisaurus* sp. Richardson, Zool. Voy. Erebus and Terror, Fishes, 1845, p. 34, pl. xxii., figs. 1-4. Van Diemen's Land.

Alepidosaurus ferox Gunther, Cat. Fish. Brit. Mus., v., 1864, p. 421 (Tas. ref. only). *Id.* Hutton, Trans. N. Zeal. Inst., xxxiv., 1902, p. 197, pl. ix. (Wellington, N. Zealand). Not *Alepisaurus ferox* Lowe, 1833, from Madeira.

Plagyodus or *Alepisaurus ferox* of Australian authors.

Fig. 18. Lancet Fish, *Alepisaurus richardsonii.*

The remarkable and little known Lancet Fish has been recorded from New South Wales, Tasmania, and New Zealand, whence some skulls have been figured. I now give an illustration of a fairly complete specimen from Lord Howe Island, from which place the species (whose trivial name, proposed by Bleeker, has been generally overlooked) has not been recorded before.

Br. 6. D., 37; A., 15; P.i., 13; V., 9; C., 18 et lat. brev.

Head (140 mm.) 4.8, depth at dorsal origin (76) 8.8 in standard length (675).

Eye, 26 mm., snout nearly 60, premaxillary 103, longest dorsal ray about 300 mm.; pectoral, 160; ventral, 50.

The teeth, of various sizes, are probably deciduous or replaced during the fish's life-time, which would account for disparities between my specimen and published illustrations. Mine has only one large canine on each side on the maxillary and dentary, followed by about seven compressed canines in upper jaw and about eleven in lower.

The extensive premaxilla has a margin of small, spaced teeth and there are some fairly large teeth near front of lower jaw. Some teeth may be missing.

Opercles and jawbones radiated. Bones of skull papery. Gill-membranes free. At least twenty short spiny gill-rakers on lower part of first gill-arch. Body naked, unusually attenuated.

Fins somewhat broken, especially the first dorsal. First ray of dorsal and pectoral fins serrated. Caudal forked, apparently without produced upper lobe.

Colour (in alcohol): Dark brownish to blackish on back, adipose dorsal, and on fin membranes. Some dots on side of head and bdy. Ground colour yellowish. Eye bluish. Teeth translucent yellowish.

Evidently a predaceous fish whose physiognomy resembles that of the Barracouta, Hairtail, Sea Pike and Frostfish by convergence.

Described and figured from a specimen (Austr. Mus., Regd. No. IA.1284) 675 mm. in standard length or about 31 inches overall. Probably grows much larger.

Locality.—Lord Howe Island. Presented by Mr. Robert Baxter, who said it feeds on "Nautilus [*Argonauta*] shell, fish and all".

Family Aulostomidae.

Aulostomus chinensis (Linné, 1766).

(Plate xxx., fig. 19.)

Here illustrated from a painting made by the late A. R. McCulloch of a Lord Howe Island example in 1902. This species is notoriously variable in colour; McCulloch's painting is almost uniform rich orange with blackish blotches on maxilla, ventral base and upper part of caudal fin; a blackish bar along dorsal and anal bases; indistinct darker stripes along back (compare Waite, Rec. Austr. Mus., iii., 1900, p. 198). Since local specimens do not exactly agree with Bloch's plate 388 they may be given a new subspecific name, *waitei*. Holotype in Austr. Mus., Regd. No. I.5370.

Family Syngnathidae.

Hippocampus angustus Gunther, 1870.

(Plate xxx., fig. 20.)

Herewith is figured, about natural size, the type of *Hippocampus subelongatus* Castelnau, 1873, from the Fremantle district, Western Australia, in the Paris Museum. I am of the opinion that *H. subelongatus* = *elongatus* Castelnau, 1873 = *angustus* Gunther, 1870.

H. hippocampus and *H. hystrix* are extralimital species which have been recorded from Queensland, doubtless on the basis of some *H. dahli* Ogilby, 1908.

Also *H. bleekeri* Fowler, 1908 = *agnesae* Fowler, 1908 = *graciliformis* McCulloch, 1911 = *Macleayina abdominalis* (Lesson, 1827).

HIPPOHYSTRIX, *gen. nov.*

Orthotype, *Hippocampus spinosissimus* Weber, 1913 = *Hippohystrix spinosissimus*.

A new generic name is provided for this very spiny Queensland species, with D. 17, rings 11 + 34, and snout equal to postorbital.

MACLEAYINA PLANIFRONS (Peters, 1877).
(Fig. 21.)

Here figured from the holotype of *Hippocampus planifrons* from Naturaliste Channel, No. 9387 of the "Gazelle" collection, in the Zoologisches Museum der Universität, Berlin, where I examined it in November, 1937.

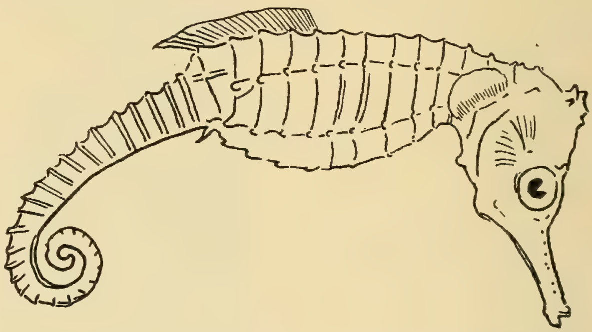


Fig. 21. Sea Horse, *Macleayina planifrons*. Holotype.

The coronet has five spines, the two anterior ones short and blunt; the supraocular spine is granulated. D. 23 or 24, on raised base. Rings, 12 or 13 + 30 and some obsolete ones towards the tip of tail.

Length (curled) 43 mm.

HIPPICHTHYS MARGARITIFER (Peters, 1869).
(Fig. 22.)

Syngnathus margaritifer Peters, Monatsb. Akad. Berlin, 1868 (1869), p. 457, Sydney.

Fig. 22. Pipefish, *Hippichthys margaritifer*.

Here illustrated from a specimen, "M. G. Bowen, 4982", in the Hamburg Museum.

Standard length, 146 mm.

Locality.—Bowen, Queensland; *ex* Museum Godeffroy.

ICHTHYOCAMPUS GALEI Duncker, 1909.
(Fig. 23.)

Here figured from the lectotype of the species, the smaller of two females in the Hamburg Museum, where Dr. Georg Duncker and Fraulein Erna Mohr assisted me in working on pipefishes in 1937.

The median ventral crista is present. Operculum without keel. Inferior and superior cristae of trunk continuous with those of tail; median

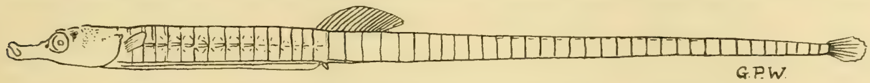


Fig. 23. Pipefish, *Ichthyocampus galei*. Lectotype.

ones obsolescent below dorsal fin. No spines on posterior tail-rings.

Standard length, 47 mm.

Locality.—Freycinet's estuary, Shark's Bay, 7 to 11 metres; W. Michaelsen, Hamburg Mus., No. 11521.

Since visiting Europe I have dredged in Shark's Bay, Western Australia, and obtained further specimens.

Genus Festucalex Whitley, 1931.

Festucalex Whitley, Austr. Zool., vi., 1931, p. 312. Orthotype, *Syngnathus cinctus* Ramsay, 1882.

Festucalex cinctus (Ramsay, 1882).

(Plate xxxi., fig. 24.)

Here figured from a specimen from the type-locality; Port Jackson, New South Wales.

Family Nannatherinidae.

Nannatherina balstoni Regan, 1906.

(Fig. 25.)

Here figured for the first time from a sketch of the holotype (37.5 mm. in standard length) which I was courteously allowed to examine in the British Museum (Natural History) by Dr. C. Tate Regan.

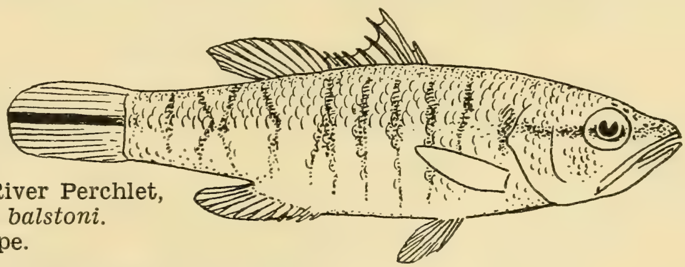


Fig. 25. King River Perchlet, *Nannatherina balstoni*. Holotype.

Locality.—King River, Western Australia.

Family Belonidae.

Djulongius groeneri (Klunzinger, 1879).

(Fig. 26.)

The accompanying sketch, made in Stuttgart, shows the holotype, No. 2601, from North Australia, about 534 mm. in standard length.

The holotype of *Belone groeneri* Klunz. is No. "2601, P. Darwin, N. Australien. v. Müller, '79". It has become very distorted by long preservation in a bottle, so the following measurements are approximate:—Head,

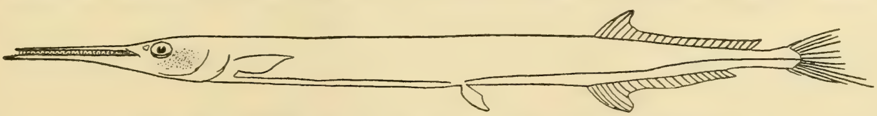


Fig. 26. Long Tom, *Djulongius groeneri*. Holotype.

from lower jaw, 155 mm. Snout to ventral fin, circa 310; to origin of anal, 395; to end of anal, 484. Standard length, 534. Total length, over 583 mm. Depth of body, 36? Depth of head, 30. Eye, 16. Pectoral, 44, slightly longer than ventrals. Depth of caudal peduncle, 12. Tip of lower jaw to eye, 99. Gape of lower jaw, 90; of upper, 84. Interorbital, 24. Dorsal origin little behind anal. D. 21? and A. 20 rays.

Radiating striae on each side of sunken naked interorbital area, rugose. Some scales forward of interorbital region. Teeth erect or sloping slightly forwards. About 17 rows of cheek-scales. Opercles naked. No gill-rakers, the anterior surface of the branchial arch villose to touch. Body-scales very small and numerous; those of lateral line scarcely forming a keel. Caudal peduncle compressed.

Belone gavialoides Castelnau, 1873, from near Fremantle, Western Australia, may be conspecific, but is described as having eye 2 in interorbital and 23 anal rays.

Family Exocoetidae.

Exonautes robustus (Gunther, 1866).

(Fig. 27.)

The accompanying figure was prepared from the holotype of *Exocoetus robustus* in the British Museum (Natural History), from "Australia".

D., 14; A., 10; P., 15; V., 6 (first 2 modified); C., 15. Predorsal scales probably less than thirty.

About 50 lateral line scales of which more than thirty are post-ventral. Pectoral fin (216 mm.) 1.4 in standard length (313), not quite reaching root of tail; dusky with median light area; 2nd ray branched. Fifteen gill-rakers on lower half of first branchial arch. Jaws toothed. Ventrals reaching beyond first few anal rays, plain in colour; their origin is nearer nostril than base of tail; first two rays flattened anteriorly. The specimen

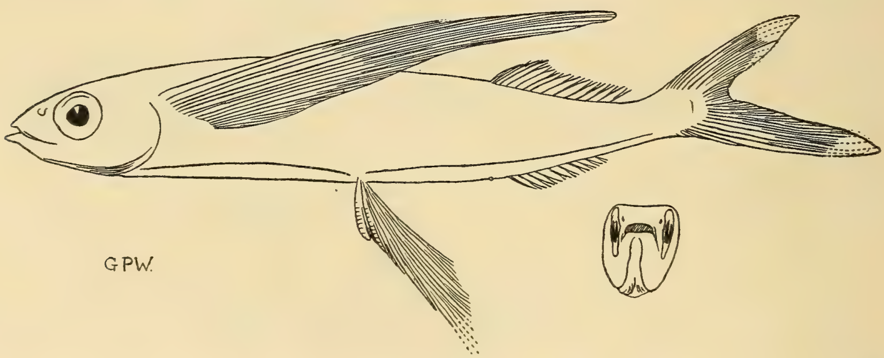


Fig. 27. Flying Fish, *Exonautes robustus*. Holotype. Also front view of face.

is very old and bent so as to make measurement difficult. The total length is over 15 inches but tips of caudal are broken. The standard length is 315 mm. and the following are the percentages, following Bruun's system, of various dimensions in the standard length:—Head (65 mm.), 21.2%; snout (19), 6%; eye (23), 7.3%; interorbital (22), 7%; pectoral (216), 68.5%; ventral (104), 33%; predorsal length (222), 70.4%; breadth of body (44), 13.9%; depth of body (55), 17.4%; height of dorsal (25), 7.9%; preventral length (circa 65 mm. on left side), 20.6%, or (circa 75 mm. on right side), 23.8%; and preanal length (circa 222), about 70.4% of standard length.

Gunther's species is not *altipennis* Cuv. & Val. It may be a subspecies of *katoptron* Bleeker (published about the same time as *robustus*) from Sumatra, but I retain the name *robustus* for the (south-western?) Australian fish, of which I have seen Fremantle specimens.

Exocoetus robustus Baird (Science, viii., July 2, 1886, p. 11, fig. 1) from the Cape Verde Islands, is a different species altogether, with D.14. A.10 and pectoral fin with a median light area.

Family HOLOCENTHRIDAE.

OSTICHTHYS AUSTRALIS (Castelnau, 1875).

(Fig. 28.)

Myripristes australis Castelnau, Vict. Offic. Rec. Philad. Exhib., 1875, Res. Fish. Austr., p. 4. Cape York, Queensland.

Ostichthys australis Ogilby, Ann. Qld. Mus., ix., 1908, p. 30. "Type" [of Ogilby's description, not Castelnau's species] in Queensland Museum. *Id.* McCulloch, Austr. Mus. Mem., v., 1929, p. 134.

Several nominal genera and species of Squirrel Fishes have been recorded from tropical Australia, some of which have not been identified since first defined. I give here the first published illustration of an Australian specimen of the family Holocenthridae.

D.x/i., 14; A.iv., 12; P.i., 14; V.i., 7; C., 17. L.lat., 28. L.tr., 2½/1/5½. Nine predorsal scales. Head (44 mm.) about 3, depth (51), 2.5 in standard length (130). Eye (21 mm.) more than twice interorbital (10). Snout, 6 mm.; longest (fourth) dorsal spine, 19; third anal spine, 15; postorbital, 17; least depth of caudal peduncle, 11.

Head bulbous, rugose. Two main interorbital ridges, with a short ridge on each side; posteriorly these expand into several fan-like ridges. Opercles strongly serrate. No enlarged preopercular spine. Eyes very large.

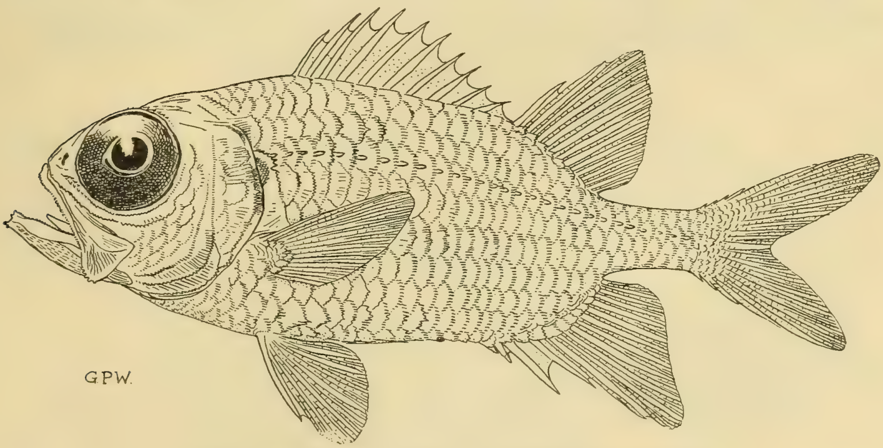


Fig. 28. Squirrel Fish, *Ostichthys australis.*

Maxillary broad, strongly striate. Bands of regular tubercular or villiform teeth on jaws, vomer, palatines, and base of tongue. A few tubercular teeth on chin, in a small patch on each side; above these are two better developed patches in lower jaw anteriorly. About 6 tubercular teeth on lower angle of maxillary.

Mostly straw-colour after long preservation in alcohol, with dark blotch

at opercular angle; the collector described it, when alive, as "altogether scarlet".

Described and figured from a specimen, 130 mm. in standard length or 6½ inches overall, from Armit Island, Whitsunday Group, Queensland; E. H. Rainford, 1922 (Austr. Mus., Regd. No. IA.889). Other specimens, up to 7¼ inches long from the same place and the nearby reefs of Port Denison and Hayman Island, are in The Australian Museum.

Comes down to *Myripristis melanostictus* Bleeker, 1863, in Weber and Beaufort's key (Fish. Indo-Austr. Arch., v., 1929, p. 258), but differs from Bleeker's figure of that East Indian species (Atlas. Ichth., ix., 1877, pl. ccclv., fig. 3, as *M. melanostigma*) in lacking the melanism, having larger eye, more slender body, convex soft dorsal margin, pectoral origin further forward, and depth of caudal peduncle about half eye.

Family NOMEIDAE.

NOMEUS DYSCRITUS Whitley, 1931.

(Plate xxx., fig. 29.)

Nomeus dyscritus Whitley, Austr. Zool., vi., 4, February 13, 1931, p. 315. Shellharbour, N.S. Wales.

Here illustrated, natural size, from a painting by A. R. McCulloch of a Maroubra (New South Wales) specimen.

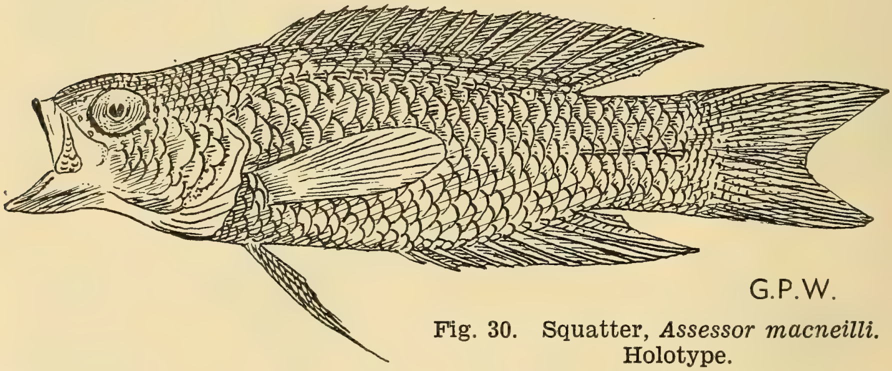


Fig. 30. Squatter, *Assessor macneilli*. Holotype.

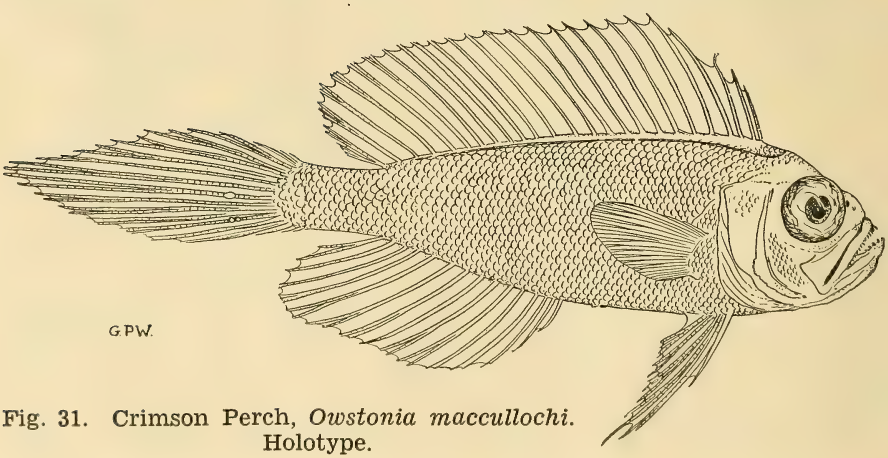


Fig. 31. Crimson Perch, *Owstonia maccullochi*. Holotype.

Family PLESIOPIDAE.
ASSESSOR MACNEILLI Whitley, 1935.
(Fig. 30.)

Assessor macneilli Whitley, Rec. Austr. Mus., xix., 1935, p. 231.

The holotype, from Hayman Island, Queensland, is now figured for the first time. In the original description, "L.lat. 8 + 7" should have been "L.lat. 18 + 7".

Family OWSTONIIDAE.
OWSTONIA MACCULLOCHI Whitley, 1934.
(Fig. 31.)

Owstonia maccullochi Whitley, Fishes N.S. Wales (McCulloch), ed. 3, 1934, supplement.

The type-specimen of this remarkable deep-sea fish, the Crimson Perch, from 130 fathoms, east of Sydney, New South Wales, is now illustrated.

Family NANNOPERCIDAE.
Genus NANNOPERCA Gunther, 1861.
NANNOPERCA OXLEYANA, *sp. nov.*
(Fig. 32.)

D.vii., 9; A.iii., 8 (9); P., 12; V.i., 5; C., 14. L.lat. obsolete. Sc. 25. L.tr. 13. About 15 predorsal scales.

Head (8 mm.) 2.6, depth (7) 3 in standard length (21). Eye (2.5) longer than high, and 3.3 in head. Snout 1.5 mm., less than maxillary (2) which is subequal to interorbital space.

Eye large, interorbital scaly. Mouth small, maxilla reaching to below anterior part of eye. Teeth largest on lower jaw anteriorly. Some large pores on vertex of head and around chin. Suborbital shallow and, like all the opercles, with entire margin. Several rows of cheek-scales; all opercles scaly.

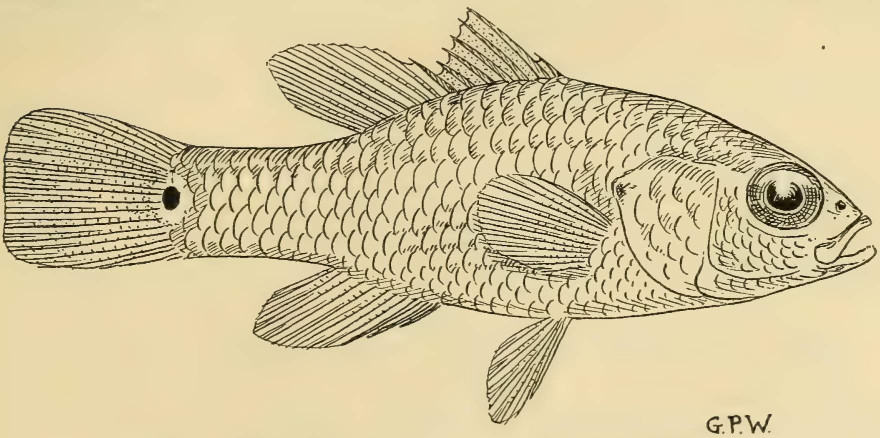


Fig. 32. Pigmy Perch, *Nannoperca oxleyana*. Holotype.

Habit percoid or apogonoid. Body covered with ciliated scales which do not extend on fins.

Dorsals united. Second dorsal spine longest, yet shorter than the rays. Anal spines increasing in length posteriorly. Caudal truncate.

Colour olivaceous, each scale with a darker margin. Tone darkest along

top of back, also there is a tendency to form rows of darker olive or brownish on lower part of flanks. Belly whitish. Eye blue. A blue dot on opercular flap. A conspicuous black ocellus, bordered above and below with orange, at base of tail.

Described and figured from the holotype, 21 mm. in standard length, or about one inch overall, the larger of two specimens (IB.523) from Moreton Island, Queensland, 27/6/40, received from Dr. Hamlyn-Harris. Eight paratypes (IA.3924) in the Australian Museum, from 30 miles inland from Coraki, Richmond River, New South Wales (Hugh James).

Range: Southern Queensland and northern rivers of New South Wales (Oxleyan faunal region, Krefftian fluvifaunula); freshwater.

A small ally, up to 1½ in. long, of the Pigmy Perch, *Nannoperca australis* Gunther, 1861, from which it differs in having deeper body, larger and fewer scales, ocellus on tail and in minor characters.

Family Epigonidae.

Scepterias lenimen Whitley, 1935.

(Fig. 33.)

Scepterias lenimen Whitley, Rec. Austr. Mus., xix., 4, September 19, 1935, p. 230. Great Australian Bight and Victoria.

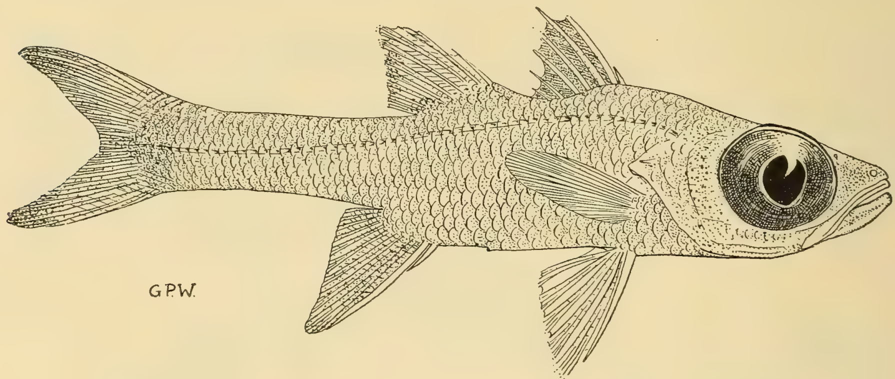


Fig. 33. Deepsea Big-eye, *Scepterias lenimen*. Holotype.

Here illustrated from the holotype (No. E.3368), 92 mm. in standard length or 4½ inches overall, from 190-320 fathoms S.W. from Eucla, Great Australian Bight.

Family Carangidae.

Caranx valenciennei Castelnau, 1873.

(Fig. 34.)

Here figured from the lectotype of the species, the larger of two specimens numbered 6434A in the Museum National d'Histoire Naturelle, Paris, where I sketched it in 1937.

Interorbital, 6 mm. Snout very slightly longer than eye.

Teeth well developed on jaws and vomer. D.viii/23?; A.ii/20. Breast scaly. About forty scutes on straight portion of lateral line plus some very small ones at root of tail. No dark humeral blotch. Standard length, 100 mm.

Locality.—Noble [or Knob] Island, Queensland.

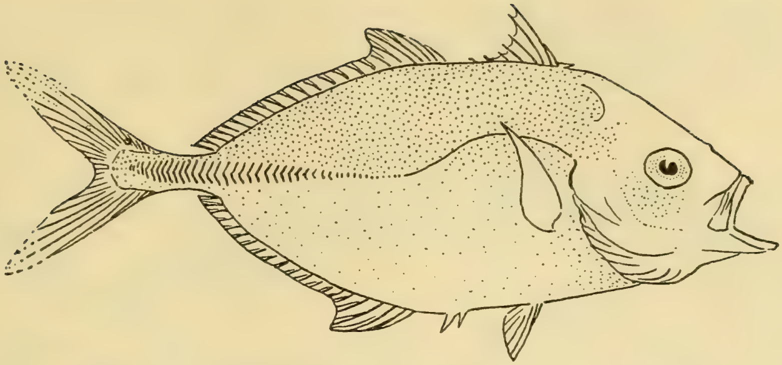


Fig. 34. Trevally, *Caranx valenciennei*. Lectotype.

CITULA DIVERSA, *sp. nov.*

New name for *Caranx altissimus* McCulloch (Biol. Res. Endeav., iii., 3, 1915, p. 134, pl. xxiv.) from south Queensland, not of Jordan and Seale, 1907, from Hong Kong. McCulloch gave the number of dorsal rays as 18-19, a mistake for 22-24.

Family SERIOLIDAE.

SERIOLA HIPPOS Gunther, 1876.

(Fig. 35.)

The Samson Fish has been long known as occurring sporadically in parts of New South Wales. Both Ogilby and Meston recorded it from Queensland and it has been noted from New Zealand. The species may now be recorded from Western Australia. I have seen it caught in Shark's Bay and have been sent photographs of other specimens from that vicinity. The Museum at Perth has two specimens (Nos. P.1225 and 1264) caught off Cottesloe.

D.vii/24; A.ii/16. Head, 55.5 and 70 mm.; depth, 62 and 72; length to end of middle caudal rays, 194 and 238; eye, 12 and 15 mm. Two or three rows of small scales over eye.

The accompanying figure was made from a large, fresh example caught off Bellefin Point on July 13, 1939, when I was holidaying in Shark's Bay. It had the following characters:— Br. 7; D.viii (4th longest) 25; A.ii/16; P.i., 17; V.i., 5; C., 19. Head, 6⅝ in.. Depth, 7⅛. Length overall, 30. Weight, 12 lb. 9¾ oz.

Eye, 1 in.; interorbital, 2⅝; snout nearly 2½; depth of caudal peduncle, 1¼; its width, 1¾ inches.

Patches of red villiform teeth on jaws, on the kite-shaped vomer, on palatines and in centre and around edge of tongue. Symphyses toothless. Margin of tongue convex. Velum maxillare white. Maxilla deep with well-marked supplemental bone, not quite reaching level of eye.

Cheeks scaly. Operculum and preoperculum naked.

Gill-membranes separate from isthmus. No pseudobranchiae.

Nine gill-rakers, shorter than eye, on lower half of first branchial arch.

Scales small, irregular, fairly imbricate in places. Breast scaly. A keel, but no scutes, on each side of tail. Vent in advance of anal fin. 24 vertebrae. Flesh white and flaky, of very good flavour and should can well, as does the allied Californian Yellowtail.

Stomach contained digested fish remains. No parasites found.
Dorsal and anal fins with sheaths. Caudal fin lunate.
Precaudal pit above and below.
Colour iridescent silvery-olivaceous above to silvery below with much

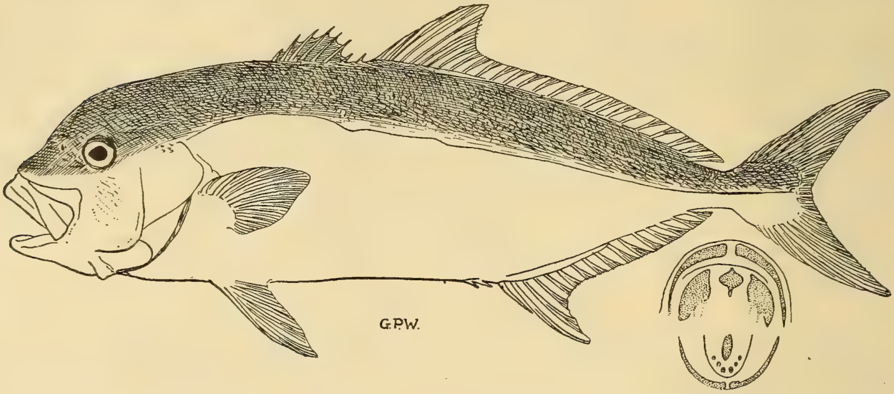


Fig. 35. Samson Fish, *Seriola hippos,* and its dentition.

yellowish tinge, especially on pectorals and sides of head. Other fins olivaceous. Eye blue, with yellow and olive iris. Inside of mouth white, except for the red teeth.

Family Sciaenidae.
Johnius novaehollandiae (Steindachner, 1866).
(Fig. 36.)

In the Württembergische Naturaliensammlung, Stuttgart, in October, 1937, I saw two type-specimens of *Umbrina mulleri* Klunzinger, 1879. I select the smaller (167 as against 175 mm. in standard length) specimen as

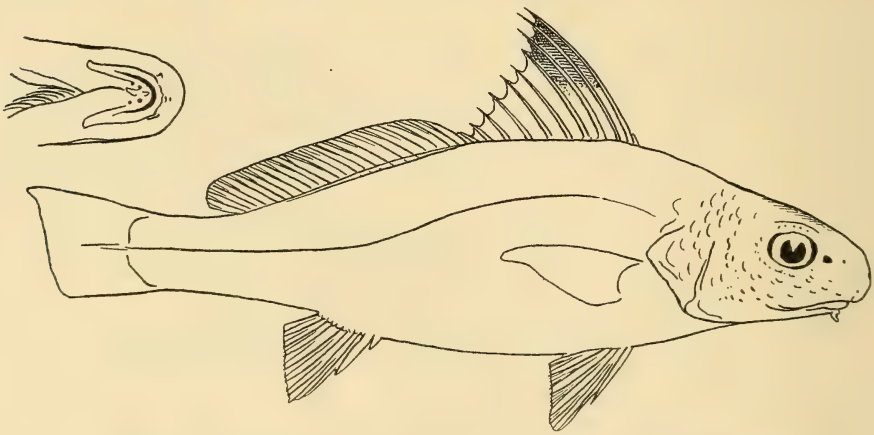


Fig. 36. Bottlenose Jewfish, *Johnius novaehollandiae* (Lectotype of *Umbrina mulleri*). Also ventral surface of head.

lectotype and figure it here. Both were labelled "2440, Endeavour R., Queensland v. Müller, '78". This belongs to the same species as *Sciaena novaehollandiae* Steindachner, 1866, of which *mulleri* Klunzinger now becomes a synonym.

SCIAENA MULLERI Steindachner, 1879.

(Fig. 37.)

Sciaena mulleri Steindachner, which was doubtfully listed as a synonym of *S. soldado* (Lac.) in McCulloch's "Check-List", is really the same species as *S. leptolepis* Ogilby, which thus falls as a synonym.

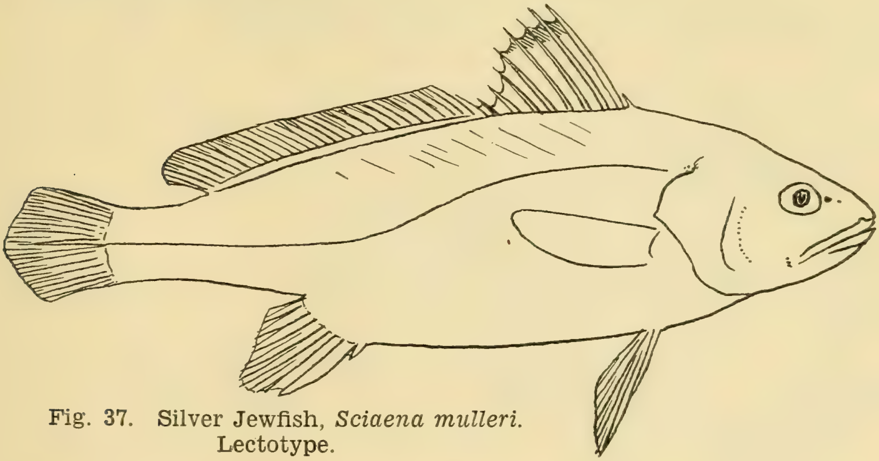


Fig. 37. Silver Jewfish, *Sciaena mulleri*. Lectotype.

The lectotype of Steindachner's species I sketched in the Stuttgart Museum, No. 2267. Clevelands Bay, Queensland v. Muller, '77. It is 275 mm. in total length, has D.ix/i., 30; A.ii., 7, and is figured here.

Family HOLACANTHIDAE.

CHAETODONTOPLUS DUBOULAYI (Gunther, 1867).

(Plate xxxi., fig. 38.)

Here figured from a specimen about 8½ inches long brought to Sydney alive from Port Darwin, Northern Territory (Austr. Mus., Regd. No. IA.8089). Colours: Ground colour dark slate-greyish with slightly brownish-red tinge on most of body and along ocular stripe. Lips dirty brownish with blue stripe along edges. Snout dull yellow. Pupil blackish, iris bright blue, ringed around with yellow. Throat yellowish on the slate-greyish ocular stripe below gill-opening. Most of postocular head white with slight bluish tinge. A broad yellow area from anterior dorsal spines downwards over the yellow pectoral and ventral fins, becoming more orange posteriorly. Here it is strongly separated by a milky white stripe from the dark ground-colour of the rest of the body, the latter being banded and reticulated with milky-white wavy lines centred with navy blue. A broad bright yellow area along base of soft dorsal fin. Most of dorsal and anal fins yellow, overlain with brown to give a dirty orange hue, darker towards bases; this yellow area is crossed by wavy bands of blue. The edges of soft dorsal and anal spines and rays are broadly bordered with bright dark blue, the border edged darker above and below. Caudal canary yellow spotted with scattered orange dots and with an inframarginal border of white (anteriorly) and deep orange (posteriorly).

Family Scatophagidae.

Selenotoca aetate-varians (De Vis, 1884).

(Plate xxxi., fig. 39.)

The type of *Scatophagus multifasciatus* var. *altermans* Castelnau, 1878, in the Paris Museum, is here figured. It evidently belongs to the genus *Selenotoca* Myers (Proc. Biol. Soc. Washington, xlix., 1936, p. 84) and the species is synonymous with *S. aetate-varians* De Vis, 1884, as are also *Scatophagus semistrigatus* Saville-Kent, 1893 (spelt *S. semistrigigena* by Innes, The Aquarium, i., 11, 1933, p. 301) and the young forms given the nomina nuda *S. brunneus* and *chameleon* by Saville-Kent.

Selenotoca aetate-varians is the eastern and northern Australian cognate of the Western Australian *Selenotoca multifasciata* (Richardson, 1846).

Scatophagus argus is represented in Australia by *quadranus* De Vis (sometimes spelt *quadratus*), whilst *Desmoprenes tetracanthus* (Lacépède) has been recorded from the Northern Territory.

For references, see Austr. Mus. Mem., v., 1929, pp. 241 and 242.

Family Latridae.

Mendosoma allporti Johnston, 1881.

(Fig. 40.)

The accompanying sketch was made by the late A. R. McCulloch from a 14½ inch specimen in the Tasmanian Museum, Hobart.

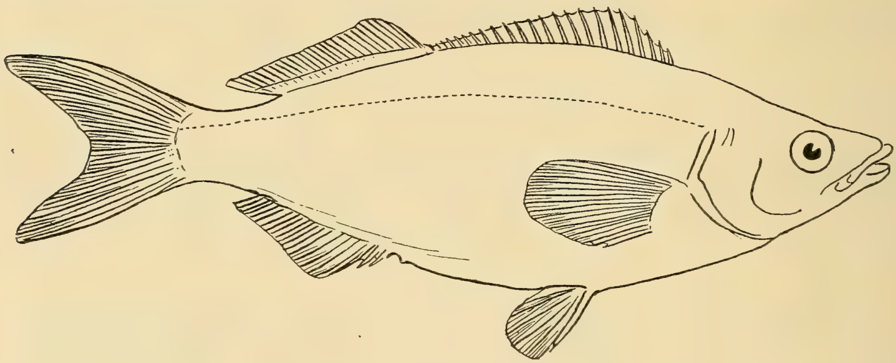


Fig. 40. Real Bastard Trumpeter, *Mendosoma allporti.*

Length to hypural joint, 317 mm. Head, 77. Depth, 106.

Jaws very protractile, the upper symphysis with microscopic teeth.

D.23/i., 25; A.2/19 (first spine, if present, hidden in the flesh); P., 18, only the small one or two lower rays simple.

Lateral line consisting of small scales intercalated between the larger ones on either side. There are about 67 to the hypural.

Family Odacidae.

Neoodax balteatus (Cuv. & Val., 1839).

(Plate xxx., fig. 41.)

The accompanying illustration is from a photograph of the type of *Odax obscurus* Castelnau, 1872, in the Museum National d'Histoire Naturelle, Paris.

The specimen came from the Melbourne Markets and has less than 40 L.lat. scales. Thus *obscurus* becomes a synonym of *balteatus.*

Family Teuthidae.

Acronurus formosus Castelnau, 1873.

(Fig. 42.)

There are two specimens of this species in the Museum at Paris of which I select the larger (standard length, 62 mm.) as lectotype. Regd. No. 7096A.

D.viii/31?. A.iii/32?. Vi/5. First ray long.

This is evidently the young stage of some Surgeon Fish, like *Teuthis,* having still the characteristic vertical body-striae.

Further specimens are needed to ascertain what the adult looks like.

Locality.—"Noble-Irland"; *i.e.,* Knob Island, Torres Strait, Queensland.

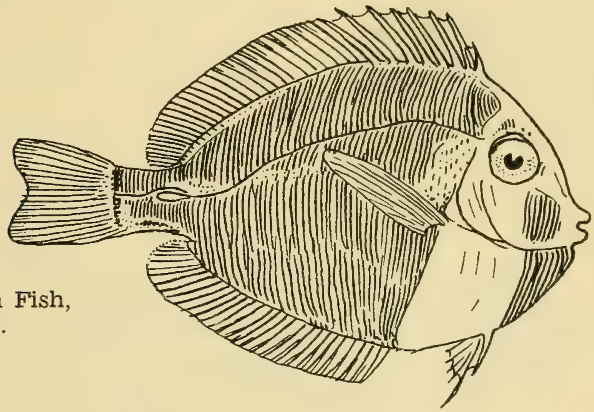


Fig. 42. Young Surgeon Fish, *Acronurus formosus.* Lectotype.

Family Parapercidae.

Parapercis (Neosillago) nebulosus (Quoy & Gaimard, 1825).

Neosillago marmorata Castelnau, from Port Walcott, north-western Australia, has not been satisfactorily identified and classified since it was first described in 1875. However, on comparing Castelnau's description with Richardson's figure (Icones Piscium, 1843, p. 4, pl. i., fig. 1) of *Percis emeryana* from Depuch Island, north-western Australia, I find the two tally very well. Thus *Neosillago marmorata* = *Percis emeryana* = *Percis nebulosus* Quoy & Gaimard, 1825, from Shark's Bay. This species enters the genus *Parapercis* Bleeker, 1863, but *Neosillago* may be retained as of at least subgeneric rank with *Chilias* as an indirect synonym.

Family Gobiidae.

Koumansetta, *gen. nov.*

Orthotype, *K. rainfordi,* sp. nov.

Body elongate, compressed, covered with circa 60 scales, ctenoid posteriorly, becoming cycloid anteriorly. Head compressed, scaled above behind eyes, cheek with embedded scales, opercle scaled. Eye in anterior half of head, interorbital narrow. Snout pointed. Both nostrils in a rim. Mouth a little oblique, upper jaw prominent. Teeth in some rows, in upper jaw outer row enlarged, in lower jaw outer row enlarged, extending to half-way along the jaw, last tooth a curved canine. Laterally inner row of teeth in lower jaw enlarged. Tongue truncate. Gill-opening not continued forward below, isthmus broad. No fleshy flaps on inner edge of shoulder

girdle. Dorsal fins separate. D.vi/i., 11; A.i., 11; V. 1, 5, the inner rays are only united at the bases to half-way along the fin, a basal membrane is not developed. Pectoral without free silk-like rays. Caudal rounded.

KOUMANSETTA RAINFORDI, *sp. nov.*

(Fig. 43.)

D.vi/i., 11; A.i., 11; P., 17. L.lat. circa, 58; L.tr., 19. Predorsal scales 26. Body elongate, compressed; height, $4\frac{1}{2}$ in length. Head compressed; $3\frac{1}{4}$ in length. Eye 4 in head. Interorbital $\frac{1}{2}$ eye-diameter. Snout pointed, about as long as eye, tip before middle of eye. Nostrils in a rim. Teeth as given in genus description. Mouth a little oblique, upper jaw prominent, maxillary extends to below anterior margin of pupil. Mucous canals indistinct. Two open pores in a median line in interorbital, some along supraopercular groove. Scales of head as is given in genus description. First dorsal fin lower than body, first ray filiform. Pectoral and ventral fins as long as postorbital part of head. Caudal rounded, shorter than head.

Colour in spirits, yellowish brown; 6 longitudinal white bands bordered with dark on each side, begin on head.

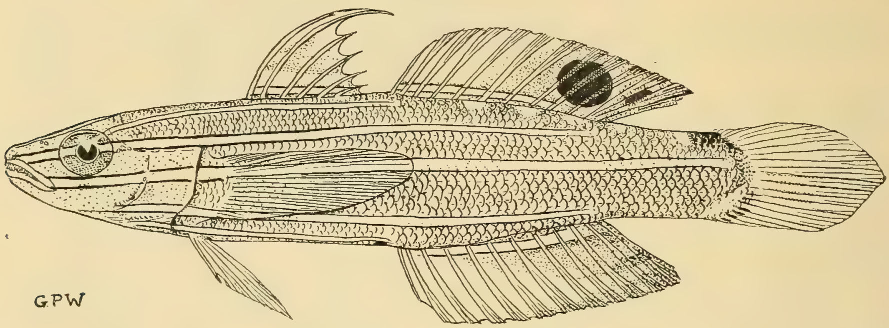


Fig. 43. Old Glory, *Koumansetta rainfordi.* Holotype.

First band reaches from tip of snout along interorbital to insertion of first dorsal fin; second from tip of snout through eye, here it is divided into two bands, the upper to half-way along second dorsal fin, the lower to upper part of caudal base; the fourth band goes from edge of mouth over opercûlum and base of pectoral on middle of side to base of caudal fin; the fifth begins on cheek, runs on lower part of base of pectoral fin along base of anal to lower part of caudal peduncle; the sixth begins on branchiostegal membranes and extends to base of ventral. First dorsal fin with white bands, bordered on each side by dark, along base. Second dorsal with a similar band, between 7th to 10th ray a black ocellus, bordered by white, tips of last rays dark. A black spot on caudal peduncle at the beginning of the upper caudal fin-rays, continued as a narrow stripe, along the bases of the rays, followed by a white bent stripe, which is followed by a dark stripe on the lower caudal rays. Anal with a similar band as second dorsal; the fin membranes of second dorsal and anal are dark. Pectorals and ventrals colourless. Length, 47 mm.

Habitat: Hayman Island, Whitsunday Group, Queensland.

Unique type-specimen (No. IA.2029) in the Australian Museum, Sydney, collected by the late E. H. Rainford in 1924.

The above description was drawn up by Dr. F. P. Koumans, of Leiden, Holland, during his visit to the Australian Museum in 1938. He determined it as a new genus and species of unusual interest, but left it unnamed, whilst I undertook to prepare an illustration of it. As I am now unable, through the exigencies of war, to continue correspondence with Dr. Koumans, I supply a generic name for this interesting fish which will enshrine memories of the happier days of our meetings in Leiden and Sydney.

Family Ophiclinidae.

Scleropteryx devisi (Ogilby, 1894).

(Fig. 44.)

Here figured from the holotype which is in The Australian Museum, not the Queensland Museum as stated in Austr. Mus. Mem., v., 1929, p. 353.

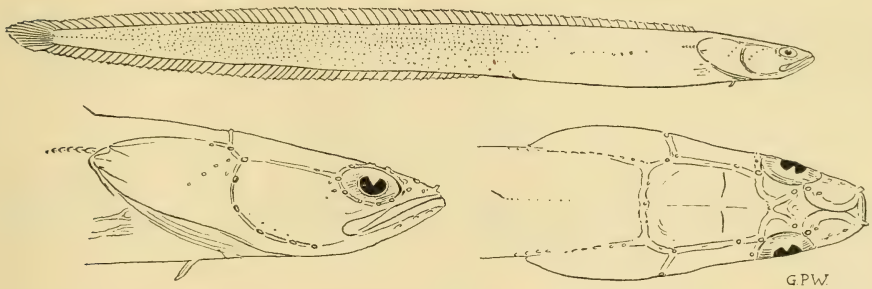


Fig. 44. Northern Snake Blenny, *Scleropteryx devisi*. Holotype.

I may record here that the "*Gunellichthys* spec." recorded from Thursday Island by Weber (Zool. Forsch. Austr., v., 1895, p. 268) was a *Notograptus guttatus*; I examined Weber's specimen when in Amsterdam in 1937.

Professor P. Schmidt of Leningrad kindly sent me copies of Herzenstein's descriptions of South Australian fishes which are missing from Australian libraries. From these I have determined that *Neogunellus homacanthus* Herzenstein, 1896, is conspecific with *N. sulcatus* Cast., or *Ophiclinus sulcatus* as described by McCulloch and Waite (Rec. S. Austr., Mus., i., 1918, p. 55, fig. 28) and equals *Ophiclinus antarcticus* Castelnau, 1872.

The *Neogunellus microchirus* of Herzenstein, 1896, is evidently the same as *Peronedys anguillaris* Steindachner, 1894.

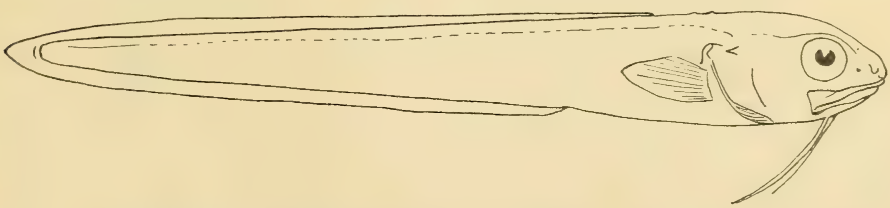


Fig. 45. Rockling, *Otophidium genyopus*. Holotype.

Family Ophidiidae.

Otophidium genyopus Ogilby, 1897.

(Fig. 45.)

Here figured from the 42 mm. holotype from Maroubra, New South Wales. The dentition was described by McCulloch (in MS.) :—

"Premaxillaries with an outer row of strong, slightly curved and spaced teeth, which are largest near the symphysis, and become smaller backwards; an inner row of smaller teeth which appears to be double anteriorly. Mandible with a narrow band of strong teeth along its whole length; no outer enlarged row as in the premaxillaries. Vomer with numerous strong teeth forming a triangular patch. Palatines with a single row of strong teeth."

Family Congiopodidae.

Perryena, *gen. nov.*

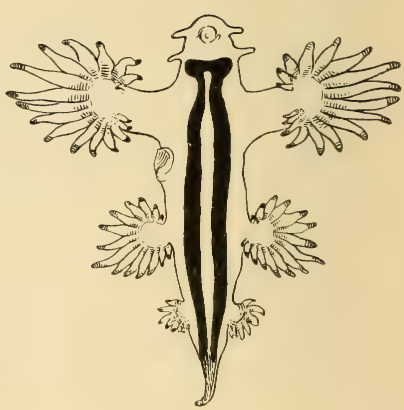
Orthotype, *Congiopus leucometopon* Waite, 1922, from South Australia = *Perryena leucometopon*.

Distinguished from *Congiopodus* Perry, 1811, by having three anal spines, fewer dorsal rays, branched pectoral rays, by the peculiar form of the snout and striking coloration of head.

AUSTRALIAN GLAUCUS.

By Tom Iredale.

In the last Proceedings (pp. 40-41, August 19, 1940) the Australian species of *Glaucus* were discussed, and sketches are now offered supplementing the notes abovementioned.



Glaucus lineatus Bergh. *Glaucilla briareus* Bergh.

G. P. Whitley del.

MARINE MOLLUSCS FROM LORD HOWE ISLAND, NORFOLK ISLAND, AUSTRALIA AND NEW CALEDONIA.

By Tom Iredale.

(Plates xxxii.-xxxiv.)

(*Contribution from the Australian Museum, Sydney.*)

In an attempt to determine exactly the relationships of molluscs from Lord Howe Island it became imperative to describe many from the adjacent lands.

Fifty years ago, Brazier supplied names for a collection of molluscs made at Lord Howe Island by an Australian Museum party led by R. Etheridge, Jr. These names were published, together with an ecological account, in a Monograph on the Island issued by the Museum. Many visits have since been made to the island by members of the Australian Museum staff, and a fairly representative collection of the larger molluscs has been accumulated. Mr. Roy Bell, about twenty-five years ago, made an excellent collection of the smaller shells by rock washing on the shore, and dredging off shore, so that sufficient material is available for a reasonable comparison to be made. The localities most commonly associated with Lord Howe Island in recent discussions have been Norfolk Island, the Kermadecs, New Caledonia and Eastern Australia. From all these places equally representative collections are at hand: from the two former, by the same collector, Mr. Roy Bell, so that exactitude in comparison is possible. The molluscs of New Caledonia have been well studied by excellent French conchologists, but they neglected the unattractive Limpets and limpet-like shells. There is probably the largest collection of New Caledonian molluscs yet brought together, in this Museum.

Brazier's names have been commonly cited, but, for the recognition of geographical relationships or alliances to-day, it is necessary that the species be more accurately determined. Thus Brazier named *Pectunculus tenuicostatus* Reeve, *Tridacna elongata* Lamk., *Lucina interrupta* Lamk., *Scutus unguis* var. *corrugatus* Reeve, *Trochus torresi* E. A. Smith, *Turbo imperialis* Linn., *Ricella plicatula* Phil., *Patella tramoserica* Martyn, *Engina armillata* Reeve, *Engina lineata* Reeve, *Fusus hanleyi* Angas, *Voluta nucleus* Lamk., *Conus anemone* Lamk., *Siphonaria denticulata* Q. & G., among others, but all these needed rectification. Some names have been already emended as *Veletuceta fringilla howensis* Ired. (= *Pectunculus tenuicostatus*), *Vulgodacna fossor* Hedley (= *Tridacna elongata*), *Lentillaria paytenorum* Ired. (= *Lucina interrupta*), *Turbo cepoides* E. A. Smith (= *T. imperialis*), and *Quibulla scotti* Ired. (= *Bulla ampulla*). It may be noted that Brazier named as new *Purpura smithi*, and a number of figures (reversed) were given on a plate, but no description included.

Scutus howensis *sp. nov.*

(Plate xxxii., figs. 5-6.)

Shell little elevated, elongate, sides parallel, mucro a little behind the centre, posterior area depressed, even slightly concave, the edge upturning a little, anterior slope slightly convex, anterior end clearly sinuate, posterior end broadly rounded. Pure white. The initial sculpture behind the mucro is wavy, closely set, concentric ridges, in front a subkeel is present which disappears early, the sculpture becoming regularly concentric ridges rather

widely spaced, some fifty being easily counted anteriorly. Lord Howe Island.

Length, 41 mm.; breadth, 21 mm.; height, 6 mm.

The diagnostic features are the flattening, the parallel sides, the regular sculpture and the upturning of the posterior end.

From Port Curtis, Queensland, the representative mollusc has an elevated shell, narrowing anteriorly, sculpture notably wavy, and shows no upturning. The anterior area slopes rather steeply and the anterior subkeel is succeeded by even a slight depression, the sinuate end well marked. Length, 30 mm.; breadth, 17 mm.; height, 8 mm. This can be named *Scutus olunguis* sp. nov. (Plate xxxii., figs. 7-8). This ranges through Queensland, the only variation being in the degree of wrinkling in the sculpture, some specimens showing this feature very strongly, the most notable being dredged shells from Lindeman Island and Hope Islands. New Caledonian shells are lower and broader, with pronounced wrinkling, though the immature are more like the young Lord Howe Island shells. This may be called *Scutus parunguis* sp. nov., the type measuring 34 mm. long, 20 mm. broad, and 7 mm. high.

Sixty years ago the conchologist at the British Museum, E. A. Smith, reviewed the shells pertaining to this group from Museum specimens. At that time he was very inexperienced and his conclusions were obviously imperfect, yet no revision has since been attempted. For all the tropical forms he used *Scutus unguis* Linn., with five varieties, ignoring all geographical considerations. As Linne's *Patella unguis* has been shown to have nothing to do with this group a renomination must be made. Hedley recently corrected the southern forms but left the northern ones to be later done. The oldest name for the "*unguis*" series is *granulatus* Blainville, from Mauritius, *sinensis* Blainville, is available for the Chinese and Japanese species (*emarginatus* Philippi, being given to a Liew-Kiew shell), while *rüppeli* Philippi, is the Red Sea species. Quoy and Gaimard introduced *imbricatus* for the New Ireland species, the other names *corrugatus* Reeve, *angustatus* A. Adams, *elegans* Gray, being introduced for shells from unknown locality, and are at present unrecognizable.

Nannoscutum, introduced recently for a Lord Howe Island mollusc (Iredale, Austr. Zool., Vol. viii., p. 244, March 12, 1937) may be a descendant of an ancestral relative of the Neozelanic *Scutus*, whose shell is so different from those of the "*unguis*" group. As the type of *Scutus* is the southern Australian species *antipodes* Montfort, the Neozelanic *breviculus* may be nearer that, and the tropical *Scutus* with the particoloured animal should be separated as a subgenus *Aviscutum* nov., with *S. olunguis* as type, the shell being more elevated, the mucro more anterior, and the anterior end deeply sinuate, while the radular details differ.

Macroschisma enopa *sp. nov.*

(Plate xxxii., fig. 9.)

Shell medium, ends rounded, sides straight, parallel, a little elevated, side slopes steep, shell twice as long as broad, foramen about half the length, narrowly triangular, posteriorly attingent. Coloration brownish white marked with purplish brown, which masses anteriorly, and also posteriorly where it is marked off by a decided line at about a quarter the length of the shell. Sculpture consists of closely packed radial ribs which are faintly granulose through intersection of concentric growth lines, which become more pronounced and almost form steps with age. Interior whitish, a notable callus surrounding the foramen.

Length, 17 mm.; breadth, 7 mm.; height, 4.5 mm.

Lord Howe Island.

It was somewhat surprising to find a species of *Macroschisma* in this locality, and to determine its apparent relationship the Australian and extralimital species had to be reviewed. It must be reiterated that the first introduction of *Macroschisma* is by Sowerby in 1839 (Conch. Illus., Fissurella, p. 5, No. 45, 1839), as this reference does not appear in Neave's Nomenclator Zoologicus. The type is the Japanese species incorrectly known as *maxima* A. Adams, and the Lord Howe Island species is apparently congeneric with that, its nearest relative being an unnamed species from New Caledonia. Sowerby named a shell *novaecaledoniae,* but it was a Tasmanian specimen quite unlike the tropical forms. The earlier name is *tasmaniae* Sowerby, and the shell is broad, the foramen short and broad, and obviously the group has developed independently. It is here generically separated with the name *Forolepas* nov., the type being the aforesaid *tasmaniae,* which ranges into southern New South Wales, through Victoria into South Australia, and is represented in Western Australia by *bakiei* Sowerby (A. Adams, MS.), which has the anterior radial sculpture much coarser. Another group is represented in South Australia by *producta* A. Adams, which is long, narrow, with very steep sides, the foramen long and narrow, and anteriorly from the foramen a broad raised ridge extends to the anterior margin. Posteriorly the foramen reaches to its margin almost excavating a fissure. This represents a different genus, which is named *Dolichoschisma* gen. nov., and the West Australian shells from Geraldton show the features in an exaggerated form. the anterior ridge developing into a spout, while the foramen, narrowly triangular, excavates the posterior margin so that it would be almost destroyed were it not reinforced internally by a thickened callus. The shell is 24 mm. long, 8.5 mm. in breadth, and 8 mm. in height, and is subspecifically named *D. p. munita* subsp. nov.

CALTHALOTIA PORTERI *sp. nov.*
(Plate xxxii., fig. 10.)

Shell trochiform, sides straight, periphery keeled in juvenile but rounded in adult, imperforate, but false umbilicus seen in young stages. Coloration greenish spotted with yellow, sometimes also with bluish, dead shells whitish with brownish, pale and dark, spots. Sculpture of scarcely nodulous concentric lirae; on the antepenultimate five with two larger forming the periphery; in the adult the last whorl has one large row below the suture, four smaller beaded rows intervening between this and the peripheral double row, the base showing seven similar scarcely beaded rows with a line between each. These are over-ridden by fine slanting threads, the nodules being sometimes distinct but more often almost obsolete. Columella arcuate, abruptly terminating in a notch, reflected over the false umbilicus, outer lip thin, slightly thickened inside. Operculum thin, multispiral, circular, horny. Height, 17 mm.; breadth, 15 mm.

Lord Howe Island.

This species has been recorded as *torresi* Smith, but is easily separated by its sculpture, while *torresi* itself has been regarded as a synonym of *arruensis* Watson, and Hedley in his MS. Catalogue has noted that the Lord Howe Island shell is nearer the New Caledonian one and that neither had been named.

The specific name is given for Dr. R. H. Porter, who made a collection at Lord Howe Island, and was interested and pleased to know this shell would bear his name.

Cellana howensis *sp. nov.*

(Plate xxxii., figs. 1, 13; Plate xxxiii., figs. 4, 5, 6.)

Brazier included *Patella tramoserica* (the common Sydney limpet) with a note "at the Admiralty Isles it acquires a much larger size". The differences have been recognized by every collector since. Shell oval, elevated, apex at anterior fourth, a little narrower anteriorly, anterior slope almost straight, longer posterior slope a little convex. Colour green with blue markings, varying through paler shades almost to greenish white with a tinge of yellow, markings rarely becoming obsolete. Internally the spatula is whitish marked with a green line, outside the spatula greenish with blue radials, the margin regularly marked with blue lines. Sculpture of numerous ribs, a little raised, becoming generally less marked with age; fairly regular and even subnodulose in the juvenile, but the nodules soon vanish, the surface crossed with minute concentric striae. According to the rock upon which the limpet occurs, the shell may be soft and eroded, the ribs less pronounced and less elevated on soft rocks, while upon hard rocks the shell is taller, harder, showing little erosion with the ribs more notable and more nodulose, the colour agreeing somewhat, the soft rocks being pale, the hard rocks dark. The young shells are a little more depressed but conical and similar in shape and coloration. Type from Ned's Beach, Lord Howe Island. Length, 31 mm.; breadth, 26 mm.; height, 18 mm.

Cellana analogia *sp. nov.*

(Plate xxxii., figs. 2, 14; Plate xxxiii., figs. 7, 8, 9.)

Shell larger than the preceding, more broadly oval, less elevated, sculpture more pronounced and general coloration more pallid. Colour white with faint darker lines only, inside all white, scapula a little duller, margin almost unmarked. Sculpture of numerous ribs, stronger and almost subnodulose, larger and smaller ribs irregularly alternating, a few standing out a little. Juveniles show the different origin of this species (which was at first regarded as an ecologic variant only) as the young shell is very depressed, white, with eight or nine notable rounded ribs, a few smaller ribs intervening.

Length, 37 mm.; breadth, 31 mm.; height, 17 mm.

Type from Roach (or the Admiralty) Islands, Lord Howe Island. The relations of these two species are at present obscure, the present species recalling a New Caledonian shell, hereafter named *eudora*, but not very clearly, while the former species, *howensis*, seems nearer the East Australian *tramoserica*.

Cellana conciliata *sp. nov.*

(Plate xxxiii., figs. 1, 2, 3, 19, 20.)

The common North Queensland shell has never been named, though it is very different from anything else.

Shell broadly oval, medium elevation, anterior slope a little convex, posterior straight, apex at anterior third. The shell with age broadens out posteriorly without increasing elevation, and forms a large thickened shelf all around the internal margin, while the tentacles leave a depression well marked on the shell. Sculpture of very numerous fine riblets, practically no concentric growth lines visible. Coloration blue-green with indistinct darker radial bands; inside, spatula of various shades of brown becoming paler with age; outside the spatula silvery blue, margin slightly marked with blue.

Length, 40 mm.; breadth, 34 mm.; height, 14 mm. Another 44 x 39 x 15.

Type from Keppel Bay, collected by H. Bernhard.

The young shell is elongate oval, thin, transparent, not much elevated. Coloration alternate radial bands of pale greenish and blackish green, at first the pale bands dominant but with age this is reversed, only narrow strips of the paler colour being seen. The sculpture is more pronounced, sometimes the ribs showing a slight nodulation.

Length, 21 mm.; breadth, 15 mm.; height, 7 mm.; 18 x 14 x 6 mm.

Cellana sontica *sp. nov.*

(Plate xxxiii., figs. 10, 11, 12.)

Harvey Johnston studied the ecology of Caloundra, South Queensland, and molluscan specimens were sent to Hedley for determination. The common notable limpet was the Sydney *Cellana tramoserica,* but smaller shells were placed on one side. Among these are two species which so far have not been recognized in New South Wales nor collected elsewhere in Queensland.

Shell elongate oval, depressed, apex at anterior third, slopes slightly convex. Coloration dirty green with obscure darker markings but holding the shell up to the light a complex tesselate pattern is revealed. Dead shells astonish by showing a dozen notable red rays with almost as many less pronounced intervening with irregular wavy blue black streaks becoming V-shaped marginad. (Obviously the shell recorded by Shirley as *"eucosmia* Pilsbry".) The sculpture consists of distant faint rounded ribs (furnishing the red lines abovementioned) with a fine concentric threading over-running these.

Inside the spatula is dull brownish to grey, not clearly defined, outside silver marked with black lines.

Type from Caloundra, South Queensland.

Length, 30 mm.; breadth, 24 mm.; height, 9 mm.

Cellana turbator *sp. nov.*

(Plate xxxiii., figs. 16, 17, 18.)

Shell small, conical, rather regularly oval, elevated, apex at anterior third, eroded, anterior slope straight, posterior convex. Coloration greenish white with few black markings. Sculpture consists of coarse nodulose radials alternating larger and smaller, about twenty-five of each.

Inside silvery white, the spatula brownish, no definite marginal markings.

Length, 15 mm.; breadth, 12 mm.; height, 6 mm.

Type from Caloundra, South Queensland.

Cellana eudora *sp. nov.*

(Plate xxxiii., figs. 13, 14, 15.)

Shell roundly oval, medium elevation, thick, apex subcentral, slopes slightly convex. Coloration pale green with a series of dark blotches round the shell near the margin, otherwise almost unspotted; inside pale silvery grey, the spatula outlined by a thick green line. Sculpture of fine radial ribs, massed into bunches of five to seven, elevated, about same width as intervals, eleven bunches being counted.

Length, 28 mm.; breadth, 25 mm.; height, 12 mm.

New Caledonia.

Type collected by A. F. Basset Hull at Lifou, Loyalty Islands; also secured at Bourail.

Family Pusiostomatidae.

Gray brought in the genus *Engina* in Beechey's Voyage for two species, *zonata* and *elegans,* describing the animal only. The calligraphy of Gray was always very poor, and in the Synopsis of the Contents of the British Museum it was printed *Enzina,* and later in his List of Genera he also wrote *Enzina* and Mörch in 1852 accepted *Enzina.* As type of *Engina,* Gray himself selected *zonata,* but while the generic name *Engina* came into use, apparently through the Adams' Brothers' definition, Tryon mentioned that *zonata* Gray, was a lost species.

Tomlin (Nautilus, Vol. xlii., p. 40, October, 1928) has endeavoured to clear up the matter, but has only further complicated it. He has stated that, according to specimens in Gray's collection, *zonata* is a Mediterranean shell, which has never been figured. Consequently, we do not yet know what *zonata* means, while we do know that Beechey did not "voyage" in the Mediterranean. Then Tomlin has pointed out the well-known fact that Reeve's *zonata* was not Gray's, and has renamed it *melanozona,* suggesting that, although Reeve recorded it from the Gallapagos, that locality was almost certainly erroneous, and that it was common in the New Caledonian Region. But Cuming, from whose collection Reeve described his *zonata,* had no New Caledonian material, and such does not agree with Reeve's figure. The only conclusion possible is that *Engina* cannot be used for the local shells and that recourse must be made to *Pusiostoma* Swainson, whose type is the well-known *mendicaria* auct., but not of Linné. The family distinction is necessary as sometimes the species have been classed under *Ricinula,* at others under *Columbella,* while Thiele has recently selected a more inappropriate place still, the Buccinidae. In addition to the Pusiostomatoid forms a series of shells of narrower form, the spire long, the mouth more open with the diagnostic glaze and wrinkles present occur, and for these *Enzinopsis* gen. nov. is proposed, Hedley's *gannita* being named as type.

Enzinopsis resta *sp. nov.*

(Plate xxxii., fig. 11.)

Shell small, elongately fusoid, spire longer than aperture, mouth open, narrow, canal short and narrow. Coloration brownish white, irregularly marked with brown. Whorls six, apical whorls one and a half smooth, remainder strongly corded concentrically, four cords being counted on penultimate whorl, subdued longitudinal rounded ribs, eleven in number on the last whorl being overrun by the concentric cords. The mouth is oval, the columella ridged, the inner lip erect as a glaze which continues boldly across the body whorl, bearing ridges; the outer lip similarly ridged internally, six ridges apparent. Operculum leaf shaped, apex terminal.

Length, 12 mm.; breadth, 6 mm.

Lord Howe Island.

Bedeva pensa *sp. nov.*

(Plate xxxii., fig. 4.)

Many years ago a common Sydney shell was named *Trophon hanleyi* by Angas, but later the South Australian name *paivae* Crosse, was incorrectly preferred. The matter was corrected by Hedley, who, however, himself erred in considering that the local shell developed into and was represented in Queensland by *contractum* Reeve = *funiculatum* Reeve. That species was named *Ergalatax recurrens* from Port Jackson, and lives alongside *Bedeva hanleyi* here, and in South Queensland, and while the former ranges

northwards to Low Isles and further, a different shell takes the place of the *Bedeva* in those localities. This shell was recorded by Shirley as *Afer blosvillei* Deshayes, a determination due to some extralimital conchologist as Deshayes's species is a native of Ceylon.

The Lord Howe Island shell recalls the Sydney *Bedeva* but is larger and broader, measuring 31 mm. long by 19 mm. broad; the type of *hanleyi*, an elongate specimen, measured 30 mm. long by 14 mm. In the island species the longitudinal ribs are bolder and the concentric sculpture stronger, the inner lip more curved and the outer more angulate externally, and more boldly lirate internally and has a much more different appearance than this diagnosis would suggest.

Lyria howensis *sp. nov.*

(Plate xxxii., fig. 3.)

Lamarck's *Voluta nucleus* was named without locality, but the name falls before the earlier *pattersonia* Perry, and it is obvious that both shells came from Norfolk Island, so that locality is here designated as the type locality. Perry's painting gives the characteristic features of the species, the purple coloration, broad shell and flattened ribs being rudely indicated. The Kermadec Islands shell is most like the Norfolk Island one but is narrower, the ribs more numerous and more sharply cut, and is here named *Lyria insignita* sp. nov. The species has been recorded from New South Wales, but the only specimens available from Newcastle are smaller, of a brown coloration and more heavily sculptured and is here called *Lyria peroniana* sp. nov. The Lord Howe Island shell differs in its green coloration and the ribs less pronounced and is nearer the New Caledonian species, *deliciosa* Montrouzier.

The shell is elongately oval, the spire pointed, shorter than the aperture, which is long and rather narrow. Coloration pale greenish with a bluish tinge in places with concentric somewhat distant broken brown lines. The apical one and a half smooth, purple, the succeeding whorls sharply closely ribbed longitudinally, the ribs fading very little on the body whorl where the base bears a few concentric grooves.

Lord Howe Island.

Length, 28 mm.; breadth, 14 mm.

Cominista norfolkensis *sp. nov.*

(Plate xxxii., fig. 12.)

This is one of the unexpected occurrences, a member of the family Cominellidae at Norfolk Island. The family is of Subantarctic range, Falkland Islands, Southern Australia and New Zealand. The molluscs are somewhat gregarious in the littoral zone, four genera with sixteen species and subspecies being listed by Powell in the Neozelanic Region. In Australia they are common in the south, a small species ranging into northern New South Wales, but it does not occur at Lord Howe Island. The Norfolk Island shell is, however, very like the Neozelanic *glandiformis* Reeve (olim *lurida* Hutton) and quite unlike the Australian species.

Shell small for the family, broadly subconoid fusiform, spire about equal to aperture, canal short open, mouth oval. Colour yellowish green concentrically lined with dull bluish and irregularly blotched with a similar shade, the darker coloration becoming obsolete in some cases and the shell dull. Apex of one and a half smooth whorls, adult whorls seven. Sculpture fine spiral threads above the shoulder, longitudinally below, a row of

nodules marking the periphery, twelve on last whorl where they develop into broad rounded ribs fading towards the canal where a rounded collar exists, with a couple of concentric grooves behind, the base with a few concentric lines. Columella sinuate connecting with outer lip by glaze, anteriorly twisting into canal, outer lip thin, subangulate below periphery of last whorl and rounded to a wide open canal. Nine raised lines inside outer lip. Operculum leaf shaped, apex terminal.

Length, 22 mm.; breadth, 12 mm.

Norfolk Island.

PLOCAMOTIS ILLUSUS *sp. nov.*

Although *Gena* is a common southern Australian shell it is much scarcer in the tropics. It occurs however at New Caledonia, but not at Lord Howe Island. Then it is found on Norfolk Island, but is not known from New Zealand or the Kermadecs.

The Norfolk Island shell is here described, and again it is not like the tropical forms but closely resembles the Sydney species *impertusa.* The coloration in the series is fairly uniform, beginning as a pale green but developing a purplish brown which dominates the adult shell, the paler coloration showing as more or less scattered triangular patches. This coloration is seen in the Sydney species, which however varies greatly from uniform dark to uniform light, with sometimes regular light banding. The shell is covered with dense closely packed striae, similar to that of the Sydney shell, but the striae are finer and more numerous. The New Caledonian shell is smooth. The Norfolk Island shell is smaller than the local one, measuring 16 mm. in length, by 9 mm. in breadth, but otherwise agrees very closely.

Family SIPHONARIIDAE.

The gregarious littoral limpet-like shells referred to this family in Australia have hitherto been commonly referred to the typical genus Siphonaria. In order to ascertain relationships exactly many species had to be examined, and it was found that many definable groups existed unnamed, the species being in a like state. While these molluscs constitute a very notable factor of the littoral molluscan fauna in southern Australia and New Zealand, and even in tropical Australia they are not prominent on Lord Howe Island, Norfolk Island or New Caledonia, although comparatively abundant at the Kermadecs, whence Oliver described many species. Yet it is not too easy to allot the small forms as the neighbouring species had to be determined, and almost twenty forms proved unnamed. While the species can be more or less easily separated when series are available and especially on the spot, it is much more difficult to distinguish them from descriptions and figures. This is due to the individual variation always seen in littoral molluscs through environmental stresses and years must be spent in the field before a working knowledge of the forms can be realised. Thus it has been found that the local species inhabit definite zones and can be collected in quantity without admixture save in their juvenile stages when they associate together. The animal features are known to differ throughout the world, the odontophore showing diagnostic variation, which has been used for generic separation which can be seen in the shells. Therefore for accurate differentiation group names are here introduced, the name SIPHONARIA being dismissed from the Australian fauna as its type is extralimital and its radular characters are unknown. In this place shell diagnoses are given by which means the molluscs can be easily determined.

Shell medium, flattened, oval, "black" inside and out, coarsely ribbed, ribs angulate, primary ribs few and notable. .. .. *Mestosiphon.*
Shell similar, flattened, apex excentric, pale inside and out, coarsely ribbed, ribs angulate, primary ribs few and notable. .. .. *Mallorisiphon.*
Shell flattened, apex a little excentric, ribbing very subdued, pale inside and out. .. .. *Planesiphon.*
Shell elevated, apex subcentral, ribbing coarse, primary ribs not pronounced, slopes convex, dark coloration outside, inside rayed with white. .. .. *Ellsiphon.*
Shell elevated, apex subcentral, ribbing coarse and numerous, siphonal ridge composed of three ribs. .. .. *Triellsiphon.*
Shell flattened, oval, ribbing coarse, ribs few, rounded, pale outside and inside, primary ribs pronounced. .. .. *Parellsiphon.*
Shell elevated, irregularly oval, slopes straight, primary ribs very pronounced, but sometimes shell densely ribbed, at others ribs obsolete, general coloration whitish. .. .. *Legosiphon.*
Shell very elevated, small, numerously ribbed, no primary ribs distinguishable, coloration dark, rayed inside. .. .. *Hebesiphon.*

Though these diagnoses read indefinitely consideration of shells indicate their necessity. Thus Mr. A. F. Basset Hull collected a series at Ponerihouen, east coast New Caledonia, and three species are separable at sight. First, a *Mestosiphon,* differing from the type, *eumelas,* in its paler coloration and smaller size with the anterior ribs more pronounced and more elevated. Second, a *Legosiphon,* again differing from the type, *optivus,* in its smaller size, more varied internal coloration and more anterior ribs. Third, a *Parellsiphon* which is flatter than the type, *zanda,* ribs more numerous and shows banded internal coloration recalling that of *Ellsiphon marza.* A large number collected by Mr. Chas. Hedley at Noumea confirm the lastnamed form, the shells being *Parellsiphon* with more the coloration of *E. marza* and obviously constitute a new species which may be called *Parellsiphon commixtus* nov. Another series from Presqile Ducos, Noumea, are all *Legosiphon* and again confirm the features mentioned, so that this may be called *Legosiphon mulinus* sp. nov. The *Mestosiphon* must also be named, *parmelas* sp. nov., as it does not agree with the Vanikoro *atra,* the nearest species, otherwise.

Mr. G. P. Whitley collected a number of small shells at Rarotonga, and, while a few appear to be referable to *Mestosiphon* and *Parellsiphon,* the bulk introduce a new generic form, *Torquisiphon percea* gen. and sp. nov., the shell elevated, the apex excentric, twisted, recalling that of *Benhamina,* the ribs numerous, depressed, siphonal ridge moderate, coloration black, ribs paler, inside deep brown, margin rayed.

Length, 10 mm.; breadth, 8 mm.; height, 8 mm.

For many years a ghost, *Trimusculus,* overshadowed the generic name *Siphonaria,* but recently the ghost has been laid through the discovery of the original publication of the name. At my suggestion the status has been determined by Rehder (Proc. Biol. Soc. Washington, Vol. 53, pp. 67-70, June 28, 1940), and the type of *Trimusculus* Schmidt, 1818, fixed as *Patella mamillaris* Linné, a species allotted to the later *Gadinia* Gray, 1824, which name it will displace. The local shells hitherto arranged under *Gadinia* are not congeneric with the Mediterranean and West African species, and I here propose *Gadinalea* gen. nov., naming *Gadinia conica* Angas, as type. The local shell (*conica*) was described as with thirty-eight ribs, but this is

the extreme number. The shell is thin, white, subcircular, depressed or conical, multi-ribbed and with a siphonal groove internally. The radular characters differ notably from those of the Atlantic group. The local group reaches to both Lord Howe Island and Norfolk Island where, however, it has only as yet been rarely found and the specific distinction is uncertain.

Ellsiphon marza *sp. nov.*
(Plate xxxiv., figs. 1, 2.)

Shell large, medium elevation, slopes convex, rounded oval, strongly regularly ribbed, ribs rounded, dual siphonal rib not greatly differentiated. Coloration green, inside liver, sometimes dark, sometimes pale, but always more or less rayed with white, the margin regularly marked. Sculpture of thirty to forty major ribs with many minor ribs developing in the intervals.

Type from Keppel Bay; collected by H. Bernhard.

Length, 38 mm.; breadth, 31 mm.; height, 11.5 mm.

This appears to be the northern representative of the New South Wales *scabra,* and is abundant at Caloundra and Keppel Bay, and ranges as far north as Port Douglas.

The Norfolk Island *"Siphonaria"* is known as *exulorum* Hanley, but only the name was published by Hanley. However, Suter has recorded a diagnostic comparison and the species may be thus known as *exulorum* Suter. It has not yet been figured and its exact relationship is doubtful, but perhaps a Fijian species is nearest. Meanwhile it is listed as *Ellsiphon* (?) *exulorum* Suter (Plate xxxiv., figs. 16, 17), and may be described thus:—Shell medium, elevated, rounded oval, apex subcentral, brown outside, ribs paler, inside dark liver margin marked with white, spatula bluish. About twenty-eight primary rounded ribs with a double siphonal rib, a few intercalating minor riblets. Juvenile shells show more white markings inside and out.

Length, 23 mm.; breadth, 19 mm.; height, 10 mm.

Parellsiphon zanda *sp. nov.*
(Plate xxxiv., figs. 7, 8.)

Shell medium, elongate oval, flattened, strongly roundly ribbed, dual siphonal rib very pronounced. Coloration pale greenish, inside greenish white, median area yellowish, margin not marked. The sculpture shows about fifteen major ribs with about as many small ones between.

Type from Low Isles, North Queensland.

Length, 24 mm.; breadth, 18 mm.; height, 5 mm.

Replaces *Ellsiphon* on the coral reefs of Queensland. On Low Isles the two were found, *Ellsiphon* being on the coralsand rock, while *Parellsiphon* lived on the coral blocks in the lagoon.

The light inside coloration, the strong ribbing and flattened shell make this recognisable, but at North West Island, Capricorn Group, a small distinct species was found which may be called

Parellsiphon promptus *sp. nov.*
(Plate xxxiv., figs. 24, 25.)

Shell small, flattened, elongately oval, anteriorly broader, ribbed, siphonal rib dual, about thirteen other single rounded ribs. Coloration greenish white uniform, inside the muscle impression brownish, outside unspotted white. Major ribs as above, no minor riblets save near siphonal ridge, where only a few occur.

Length, 12.5 mm.; breadth, 10 mm.; height, 4 mm.

Parellsiphon innocuus *sp. nov.*
(Plate xxxiv., figs. 9, 10.)

Shell very small, elongate oval, elevated, many-ribbed, brownish, the ribs white, the siphonal dual ribs pronounced. Coloration brownish, ribs white, interior whitish rayed with brown, interior of muscle scar whitish, scar itself ill-defined brownish.

Sculpture of twenty to twenty-five major ribs and a few minor ribs, the juvenile showing eleven plus the dual rib.

Length, 11 mm.; breadth, 8 mm.; height, 4 mm.

Norfolk Island.

This species is smaller, less elevated, and different shape and stronger ribbing than *exulorum*.

With it are a few immature shells which appear to represent a species of *Mestosiphon*.

Triellsiphon acervus *sp. nov.*
(Plate xxxiv., figs. 22, 23.)

Shell small, subcircular, elevated, many-ribbed, whitish, siphonal ridge composed of three ribs fused together. Coloration greenish white outside; inside white, the muscle impression being pale greenish and similarly internally. Sculpture of about forty-five rounded attingent ribs all about the same strength, three coalescing to form the siphonal rib. There are no riblets apparent, the ribs being too closely packed.

Length, 17 mm.; breadth, 15 mm.; height, 6.5 mm.

Type from Canala, New Caledonia.

Quite unlike any other group, the composition of the siphonal ridge and multi-ribbing being characteristic.

Mestosiphon eumelas *sp. nov.*
(Plate xxxiv., figs. 5, 6.)

Shell medium, flattened, elongate oval, strongly ribbed, siphonal ridge of two conjoint ribs. Coloration uniform blackish outside and blackish brown inside. Sculpture of major distant ribs, rounded, with minor ribs in the intervals. In the juvenile about seven major ribs stand out distinctly, and in the adult the major ribs are about doubled with a few subordinate ribs between. The dual siphonal ribs project notably, and the succeeding posterior rib is distant.

Type from Snapper Island, North Queensland.

Length, 18 mm.; breadth, 14.5 mm.; height, 5 mm.

This species ranges along the Queensland coast through the tropics and has been called *atra* Quoy & Gaimard, but the Vanikoro shell has a much more even ribbing.

A small dark shell occurs among the coral blocks at Lord Howe Island and is here named *Mestosiphon lentulus* sp. nov. (Plate xxxiv., figs. 14, 15). Shell small, flattened, brownish to black, strongly acutely ribbed, siphonal dual rib very prominent. Coloration brownish to black uniform outside, uniform dark within. Anteriorly there are seven distinct ribs, and posteriorly six with a few minor intercalating riblets, as well as the dual rib. The major ribs are double those of a juvenile of the same size of the preceding species, and more prominent, the ribs projecting more marginad.

Length, 11 mm.; breadth, 8.5 mm.; height, 3 mm.

The juvenile shows more eccentricity than that of the mainland species with the anterior ribbing less pronounced.

Mallorisiphon oppositus *sp. nov.*

From many places in Queensland the shell known as *"atra"* has been collected, and the name was selected for use on account of its uniform dark blackish coloration. Mr. H. Bernhard collected at Keppel Bay shells of the same appearance, but with a clear white internal appearance and pale brownish outside. Some have the inside of the muscle scar spotted or blotched with dark brown, while juveniles often show a pale liver and white rayed interior. However, these show the distinction from the *"atra"* series as the apex is notably excentric, that of *"atra"* being normal. The major ribs are more pronounced and remain so even in senile shells. Shell elongate to suboval, depressed, strongly ribbed, siphonal ridge of two fused ribs strongly elevated and projecting beyond the margin. The major ribs are very pronounced and number about twelve, minor riblets occurring between, but only rarely developing into a large size. Coloration in juvenile pale greenish, becoming darker to brownish outside, the interior greenish white, sometimes rayed with liver, generally whitening blotched with brown. The apex is excentric, the anterior area longer than the posterior and the siphonal side broader than the other.

Length of largest specimen, 28 mm.; breadth, 24 mm.; height, 7 mm.

Also collected at Facing Island, Port Curtis, and in Fiji a similar shell occurs, sent to this Museum under an entirely erroneous name.

Legosiphon optivus *sp. nov.*

(Plate xxxiv., figs. 26, 27.)

Shell medium, conical, side slopes straight, oval, strong major ribs angulating margin, dual siphonal ridge prominent. Coloration white, brown speckles arranged concentrically in the intervals between the major ribs. Four major ribs adorn the anterior half, broader than the posterior which also bears four major ribs. The intervals bear three to seven minor ribs, the median one usually more pronounced than the others. Internally the coloration is striking, the white ground being clouded with a delicate brown, the muscle scar deepened into a dark shade, and a central dark brown blotch present.

Type from Magnetic Island, Queensland.

Length, 22 mm.; breadth, 18 mm.; height, 8 mm.

A characteristic group showing much local variation and the differences are difficult to evaluate at present. Thus the typical form is very like a Philippine Island shell, while we get three extreme forms otherwise in Queensland, excluding the wonderful *mirificus*. Thus from Green Island, off Cairns, Two Isles, north of Cooktown, and even at Fisherman Island, Port Moresby, Papua, the shell is still white, the interior less deep brown and the edges commonly rayed, but the sculpture is dense ribbing, forty fairly equal ribs being counted and the dual siphonal rib well marked but not outstanding greatly. On the other hand, from Lindeman Island, Lizard Island, Murray Island, the shells are boldly sculptured, but the coloration inside is brownish.

Legosiphon mirificus *sp. nov.*

(Plate xxxiv., figs. 28, 29.)

Shell small, elevated, side slopes straight, smooth, the siphonal ridge only showing faintly. Coloration white, inside edge whitish succeeded by suffusion of brownish, the muscle scar dark reddish brown, inside pale brown, the centre dark brown.

Length, 19 mm.; breadth, 15.5 mm.; height, 8 mm.

Magnetic Island, near Townsville, Queensland. Collected by A. F. Basset Hull.

This is an extraordinary development as it shows the coloration inside and out of *L. optivus,* but the ribs are completely missing. Thousands of specimens belonging to this family have been handled, but nothing approaching such a form has been otherwise seen. Generally the ribbing is intensified and always the major ribs occur.

LEGOSIPHON DENSATUS *sp. nov.*
(Plate xxxiv., figs. 18, 19.)

Shell large, elevated, side slopes straight, densely ribbed, siphonal ridge of two ribs not fused, and not prominent. Coloration white with brown blotches, intervals of ribs sometimes darker. Sculpture of about thirty primary ribs with about the same number of minor intercalating ribs, the basic juvenal series not being distinguishable. Interior whitish, the margin marked with brownish, the muscle scar brown, internally darker.

Length, 28.5 mm.; breadth, 24 mm.; height, 12 mm.

Type from Port Douglas, North Queensland.

PLANESIPHON ELEGANS *sp. nov.*
(Plate xxxiv., figs. 3, 4.)

Shell small, thin, flattened, oval, the siphonal ridge indistinct, regularly sculptured with about twenty primary ribs, three or four fine riblets between each. Coloration pale greenish, inside greenish white, duller in centre, obscurely rayed with blackish. The ribs are low and not prominent, the intervening riblets being almost thread-like. The siphonal ridge is scarcely distinguished from the other primary ribs. It may be noted that the apex is excentric.

Length, 19.5 mm.; breadth, 15.5 mm.; height, 5 mm.

Collected by Mr. H. Bernhard at Keppel Bay, Queensland.

PLANESIPHON SORANUS *sp. nov.*
(Plate xxxiv., figs. 20, 21.)

Shell small, thin, depressed, suboval, siphonal ridge marked by a dual rib, otherwise the sculpture consists of about sixteen similar elevated rounded ribs, the interstices smooth or with one minor riblet. Coloration pale green, the ribs white. The ribbing is prominent through the white coloration. Inside the muscle scar is greenish, the edge white with a few dark rays.

Townsville, Queensland.

Length, 13 mm.; breadth, 9.5 mm.; height, 4 mm.

HEBESIPHON MONTICULUS *sp. nov.*
(Plate xxxiv., figs. 11, 12, 13.)

Shell small, oval, very conical, sides straight, sculpture regular ribs, siphonal ridge of two ribs little separated. Coloration dull brownish outside; inside muscle scar greyish to brown, the edge well and regularly marked with red radial colour lines agreeing with rib spaces. The ribs are elevated for size of shell, regular, about thirty in number, growth lines ornamenting the interstices.

Length, 10 mm.; breadth, 8 mm.; height, 8 mm.

Lifu, Loyalty Islands, New Caledonia.

TALISIPHON TASMANICUS Ten-Woods.

The species known as *S. zonata* Twds., must bear this name as already pointed out, but it is necessary to name the form from Port Fairy, Victoria,

which is almost smooth, measuring 19 mm. long by 15 mm. broad and 8 mm. high, so it is here called *T. t. nereis* subsp. nov. The West Tasmanian form, on the other hand, is very tall and more coarsely sculptured and may be named *T. t. turritus* subsp. nov., the type having been collected by Mr. A. F. Basset Hull at Macquarie Harbour, and measures 24 mm. long by 18 mm. broad by 15 mm. high, the typical South Tasmanian shell only reaching 12 mm. in height. The genus *Talisiphon* nov., is based on *virgulata* Hedley, the shell very elevated, sides straight, ribs numerous and flattened, siphonal ridge ill-defined, coloration dark, regularly rayed.

Cuttlefish Bones.

The "bones" of Cuttlefish have been well studied in Australia, where they are abundant at times on the beaches all round the coast, and continued examination has proved localization of the species and genera of Cuttlefishes. Hence a collection from Lord Howe Island should prove valuable as no Cuttles live in New Zealand. Seven forms of "bones" have been procured in some quantity by Mr. Robert Baxter, and six of these prove to be common Eastern Australian forms, while one is endemic. The lastnamed appears to be the common local species, and is a delightful evolution. At first sight it seems to be merely *Solitosipia mestus* from Sydney with the spine broken off. Upon examination it proves to be naturally spineless. The only spineless forms hitherto known from Australian waters belong to *Sepiella* and this only occurs in Northern Territory as yet. The Lord Howe Island shell is nothing like *Sepiella,* and agrees generally with *Solitosepia mestus,* save for the lack of the spine which is not seen even in the smallest specimen. The shell is therefore named *Blandosepia baxteri* gen. & sp. nov., the type measuring 74 mm. long by 32 mm. broad, the largest shell reaching 90 mm. by 37 mm.

At present the species stands alone, but later it is possible that the genus may include the *mestus* spined series, which disagrees from typical *Solitosepia* in many features.

EXPLANATION OF PLATES.

Plate xxxii.

Figs. 1, 13. *Cellana howensis* Iredale.
„ 2, 14. *Cellana analogia* Iredale.
„ 3. *Lyria howensis* Iredale.
„ 4. *Bedeva pensa* Iredale.
„ 5, 6. *Scutus howensis* Iredale.
„ 7, 8. *Scutus olunguis* Iredale.
„ 9. *Macroschisma enopa* Iredale.
„ 10. *Calthalotia porteri* Iredale.
„ 11. *Enzinopsis resta* Iredale.
„ 12. *Cominista norfolkensis* Iredale.

Plate xxxiii.

Figs. 1, 2, 3. *Cellana conciliata* Iredale.
„ 4, 5, 6. *Cellana howensis* Iredale, juv.
„ 7, 8, 9. *Cellana analogia* Iredale, juv.
„ 10, 11, 12. *Cellana sontica* Iredale.
„ 13, 14, 15. *Cellana eudora* Iredale.
„ 16, 17, 18. *Cellana turbator* Iredale.
„ 19, 20. *Cellana conciliata* Iredale (senile).

Plate xxxiv.

Figs. 1, 2.	*Ellsiphon marza* Iredale.
„ 3, 4.	*Planesiphon elegans* Iredale.
„ 5, 6.	*Mestosiphon eumelas* Iredale.
„ 7, 8.	*Parellsiphon zanda* Iredale.
„ 9, 10.	*Parellsiphon innocuus* Iredale.
„ 11, 12, 13.	*Hebesiphon monticulus* Iredale.
„ 14, 15.	*Mestosiphon lentulus* Iredale.
„ 16, 17.	*Ellsiphon* (?) *exulorum* Suter.
„ 18, 19.	*Legosiphon densatus* Iredale.
„ 20, 21.	*Planesiphon soranus* Iredale.
„ 22, 23.	*Triellsiphon acervus* Iredale.
„ 24, 25.	*Parellsiphon promptus* Iredale.
„ 26, 27.	*Legosiphon optivus* Iredale.
„ 28, 29.	*Legosiphon mirificus* Iredale.

BALI SHELLS.

By Tom Iredale.

The island of Bali, situated at the eastern end of Java and separated by a narrow strait from Lombok to the west, is famous through the natural history world as the location of Wallace's Line. The co-formulator of the theory, now known as the Darwinian Theory, A. Russell Wallace collected land animals on the two islands, Bali and Lombok. To his amazement, though the natives spoke "Javanese", the animals on the latter place differed entirely, belonging to the Australian fauna, while those of Bali were typically Indo-Malayan. It was obvious that marine animals would not be amenable to the same laws as land animals, so that a collection of marine mollusca from Bali has been examined with interest. Mr. Ted Dranga, of Honolulu, has presented to the Australian Museum a collection of Balinese shells, numbering over two hundred and fifty species. These are so similar to a collection from North Queensland that nearly every species could be named at sight, most of the strangers occurring on the east of New Guinea, having travelled along the north coast of that island. Only one or two are unknown in these areas, such as *Marginella quinqueplicata* Lamarck, and a *Donax* quite unlike any local form, probably *Hecuba pubescens* Linn.

A REVIEW OF THE RELATIONSHIPS OF THE MOLLUSCA OF LORD HOWE ISLAND.

By Tom Iredale and Joyce Allan.

Contribution from the Australian Museum, Sydney.

Many articles have been written regarding the alliances of the known fauna and flora of Lord Howe Island, but the matter is still open for further discussion. The present contribution from a specialised angle offers some additional and unanticipated evidence.

The basis of this article was read at Canberra before the Australian and New Zealand Association for the Advancement of Science in January, 1939, and aroused so much interest that an abstract was published in the Proceedings. Since then continued study enables us to provide a more complete account, and it may be noted that in the short interim two note-worthy accounts concerning the island have appeared. An excellent and historical account of the Birds by K. A. Hindwood was published in the Emu, Vol. xl., pt. i., July, 1940, and also issued separately, while a purely historical account to the year 1888 entitled "Lord Howe Island" had appeared a little earlier in the Royal Australian Historical Society's Journal and Proceedings, Vol. xxvi., pt. ii., April, 1940, by H. A. Rabone, and this has also been issued separately. Full bibliographies are appended in each case.

Most reviews of the island's fauna have been based on a study of the names recorded in other groups, together with the particular one which was the student's own knowledge. To support the conclusions later produced, a few recent special results may be quoted. The first definite association seems to be that by Iredale (Proc. Mal. Soc. (Lond.), Vol. xi., p. 51, March, 1914) thus:—"Lord Howe Island again shows little direct kinship with either of the other two groups (Norfolk Island and the Kermadecs). The terrestrial fauna, the marine fauna, and the flora all agree in indicating this group as an outlier of New Caledonia. The Neozelanic element is entirely missing in every branch, but 'the neighbourhood of the Australian continent has made an impression . . . on the . . . island'." This statement was made to counteract the impression gained from a study of the Loricates by Hedley and Hull, and more material has entirely confirmed the view, now also accepted by Hull. It may be shortly recorded that the Loricates are positively of New Caledonian relationship and show no near affinity with Australian forms. Iredale continued (Trans. New Zeal. Inst., Vol. xlvii., 1914, p. 508, July 12, 1915):—"The Lord Howe land Mollusca are fairly numerous in species and genera, and many of large size; they confirm recent land connections and leave no doubt as to its former attachment to New Caledonia, whilst they prohibit any land connection thereof with New Zealand. . . . As far as land molluscs are concerned, there is not the slightest reason for their quotation in favour of a Neozelanic connection". Oliver, having studied the vegetation and flora modified this (Trans. New Zeal. Inst., Vol. xlix., 1916, pp. 94-161, July 6, 1917):—"The plants of Lord Howe Island indicate former land connections with both New Zealand and New Caledonia. The greater degree of peculiarity in the New Zealand elements points to the earlier severance of that connection. No close connection with temperate Australia need be postulated to explain the affinities of the flora of Lord Howe Island and the continent. The last land

Showing former Zoological Land-connections with Lord Howe Island.

Rex Iredale del.

connection being with New Caledonia, Lord Howe Island, ought properly to be considered an outlier of that region".

Hindwood (Emu, Vol. xl., pp. 18, 22, July, 1940) has brought together all the data concerning the Avifauna and concluded:—"The present distribution of birds . . . indicates a former land connection, or a very close association, with New Caledonia, and a closer (? much weaker) association, though not necessarily a connection, with New Zealand. Lord Howe Island does not seem to have been connected with the Australian continent at any time, except, perhaps, indirectly through New Guinea". The word "closer" is obviously a *lapsus.* The question of former land connections is one which appears to depend more upon paleontological than geological evidence for a reasonable interpretation. The commonly cited bathymetric depths are not absolutely sufficient to determine the past elevation of land areas as it seems apparently impassable depths may have been caused by recent action. Thus a map showing former land areas based upon the Challenger soundings is not representative of the facts gained otherwise. It must be remembered that the Challenger soundings have been much modified by recent more exact data. It has been asserted, and accepted, that there existed (possibly during the Mesozoic or early Tertiary times) a large continental mass embracing New Zealand, Lord Howe Island, Norfolk Island, New Caledonia, Fiji, and the Solomons connecting New Guinea. This was entirely separated from Eastern Australia, which was however joined to New Guinea by a land bridge across Torres Strait. Recent investigations suggest that such a land mass was never stable, and that possibly the whole mass was never continuous simultaneously. Thus there is evidence of two Torres Strait land bridges at different times, and that there may have been direct association with New Caledonia and Australia. An alternative map is here given drawing attention to these details, with the proviso that when the Coral Sea was closed in the south, there was an outlet in the north-east through the Solomon Group, and that at some time there must have been a slight connection between New Caledonia and New Zealand. This would allow that the Coral Sea was open one way or the other all the time, and it is well known there is a serious zoological break in the Solomon Group, although physically the group seems quite a continuous chain. Practically all the essays on the geographical relationships of the places mentioned have been based on study of the terrestrial fauna and flora, most authors avoiding marine faunal evidence. Many marine animals have free swimming larvae, often pelagic, and thus have a widespread dispersal. These must be eliminated in the consideration of faunal connections, but the study of marine larval forms is very incomplete. The bulk of the littoral marine fauna does not possess free swimming larvae, the larvae depending upon dispersal by means of ocean currents through drift. Here temperature controls to some extent as the frail creatures cannot withstand great changes, and thus fail to gain much ground by drift dispersal. With regard to marine molluscs, which this essay exploits, the notable swimming larvae such as *Sinusigera, Macgillivrayia, Agadina,* etc., are fairly well known, and generally able to be detected even in the mature molluscs.

The present review is based on autoptic knowledge of the molluscs and molluscan habitats of Lord Howe Island, confirmed by large collections from the island and adjacent localities hereafter mentioned. We first note that the littoral fauna is very poor when contrasted with that of the Australian

or New Zealand shores. Curiously the notable forms recall those of the Sydney district, *Bembicium, Melanerita, Melarhaphe, Nodilittorina* and *Cellana* occurring on the exposed rocks. To detail these items, *Bembicium* is apparently an Australian development from a Littorinoid source, ranging abundantly round southern Australia and up the east coast into the Tropics, where it becomes smaller and scarcer. It is well established as a small shell on Lord Howe Island, but also on Norfolk Island, though not on New Caledonia, and possibly rarely in the extreme north of New Zealand. In the eastern Pacific it appears to be represented by the very small *Peasiella,* which seems to miss New Caledonia and Lord Howe Island, but reappears in North Queensland on the mainland (not on the Great Barrier Reef) and even Northern Territory. *Melanerita,* the Sydney "Periwinkle", whose range coincided around southern Australia, is commonly found at Lord Howe Island, and even Middleton and Elizabeth Reefs (Iredale, Austr. Zool., Vol. viii., p. 251, March 12, 1937) and Norfolk Island, but not at New Caledonia, yet occurs throughout the North Island of New Zealand. *Melarhaphe* is represented by a southern form, which has an extensive range through Southern Australia and New Zealand, but with it appears *Nodilittorina,* a nodulose Littorinoid, a large species restricted otherwise to the east coast of Australia, reaching the Tropics only. It is there displaced by a smaller northern species, but neither of these reach New Caledonia or New Zealand. Coincident in range in eastern Australia is *Hinea brasiliana,* which is represented northwards by *Planaxis sulcatus.* The latter only occurs at New Caledonia, and neither reach New Zealand. though curiously enough *Hinea brasiliana* was found at the Kermadecs.

Now Limpets are very common in New Zealand and East Australia, but rare in New Caledonia. Two species of *Cellana* live on Lord Howe Island, one on the main island, and the other on the Roach (or Admiralty) Islets. The common form recalls the east Australian *tramoserica,* but is different from the Neozelanic forms, while the Roach Islet species may be a very modified relation of the New Caledonian species. It will be concluded from reading the above that there appears to be evidence of a closer approach to the Continent than hitherto allowed, and this is confirmed by the occurrence of the Sydney Whelk. The Sydney Whelk *Pyrazus ebeninus* is restricted to east Australia, stopping at Bass Strait and diminishing in size as it reaches northward as far as Cairns. Associated with it on the mud flats and estuaries is the smaller *australis,* with an even less extensive range. Many years ago dead specimens were found on the lagoon beach of Lord Howe Island, but no living specimen occurred. Yet these species live on flats exposed at half tide, so the puzzling occurrence of dead shells was a mystery. Too late to confirm the account, we were informed that the dead shells were washed from a bed on the side of the mountain, a solution which had not been anticipated as it opens up such avenues of speculation, suggesting subsidence of a more extensive eastward-reaching plateau, and later upheaval of some portion at the place indicated.

There can be no doubt that Lord Howe Island has undergone many partial upheavals and depressions in the past. Having noted the apparent continental alliances of the littoral molluscs, it is found that those of the remainder are of New Caledonian relationship. One other mollusc of eastern Australian origin is *Bedeva pensa,* a rather lonesome form, as the Sydney *Bedeva hanleyi* is a gregarious carnivorous associate of the Oyster Drill, *Morula marginalba,* a widespread mollusc of no zoogeographical import as it ranges through the Tropics eastward to Africa.

Sea Ears are of very restricted range in the temperate waters of Australia, and many different forms have evolved. The Lord Howe Island shell is a small one of tropical facies whose nearest relation is obviously the New Caledonian *hanleyi.* A *Macroschisma* occurs, and this was unexpected, as the group is rare in the Tropics, though similar looking shells range round southern Australia, and even reach into southern New South Wales. None reached Sydney, and the Lord Howe Island species (*enopa*) is very like a rare New Caledonian shell belonging to the tropical series. The most notable mollusc is a species of *Turbo* (*cepoides*) which is quite unknown elsewhere save on the Middleton and Elizabeth Reefs, and it has been determined as a curious evolution from the *Turbo petholatus* group. The Cats' Eye shell (*T. petholatus*) is a highly polished, brightly colored shell with a wide range showing little variation, yet here a distinct species has been produced, although the New Caledonian form is scarcely separable from the type. Following up this line of research, Trochoids generally have restricted habitats, so that these are valuable for zoogeographical purposes. None is common, but it may be observed that *Austrocochlea,* the common Sydney Winkle, is missing, nor does the tropical *Monodonta* occur either. The most common Trochoid is the tropical form, *Calthalotia porteri,* whose allies live in New Caledonia and further north. Other Trochoids include *Clanculus stigmatarius, Clanculus thomasi* (= *howensis* Salisbury), *Trochus calcaratus, T. lamberti, Talopena lifuana, Phasianotrochus fournieri,* etc., all well known New Caledonian species, some rarely occurring in Queensland. In this connection may be noted that most of the New Caledonian shore shells that occur in Queensland seem to appear at the Capricorn Group first. Swimmers from New Caledonia occur on the Outer Barrier in the north, and in this matter may be cited the *Scutus.* This genus is represented by a peculiar form of the *"unguis"* series, which is unlike the normal tropical shell so-called, and has been named *howensis.* It is most like the New Caledonian shell, and the Capricorn Group shell is more like this than it is like the North Queensland shell which, moreover, reaches south to Moreton Bay.

More interesting, however, is the small *Nannoscutum* (*forsythi*), a miniature of *Scutus,* with a large long-tailed animal. This is not uncommon at Lord Howe Island, and was found at Elizabeth Reef, but is not yet recorded from New Caledonia, though it occurs on the Queensland reefs, at Michaelmas Cay and the Capricorn Group.

A quaint-like harp-like Volutid, *Lyria pattersonia,* is not uncommon at Norfolk Island and has been recorded from Lord Howe Island, Norfolk Island, the Kermadecs and Eastern Australia. A different species, *L. deliciosa,* occurs in New Caledonia, and, upon comparison, the Lord Howe Island shell (*howensis*) is very like the New Caledonian one, and unlike the others.

The bulk of the other notable shells, such as Strombs, Cowries, Cones, Tuns, Whelks, etc., is mostly of northern origin, and generally has arrived through New Caledonia. Comparatively recently a beautiful *Tonna melanostoma* was picked up, and a large Trumpet shell, *Charonia tritonis,* a very well known tropical shell, was found alive on the edge of the reef whence not even a fragment had been seen before. Here may be quoted a comment from the 1889 Memoir on Lord Howe Island (p. 25):—"Dead specimens of *Triton cynocephalus* Lamk., and *Pterocera chiragra,* var. *rugosa* Sby., were found, but Mr. Brazier, without additional evidence, is disinclined to regard these as other than conveyed to the island through

human agency. They are New Caledonia species, and have not been traced so far to the south-east before". The exact opposite is the view to-day, and if a thorough examination of the molluscs of the outer edge of the Lagoon reef were made, probably many more New Caledonian molluscs would be found. The above instances are sufficient to indicate exactly the nature and apparent origin of the univalve fauna, and when we turn to the bivalves we do not anticipate any help. Bivalves generally have a wider range than univalves, and there are fewer with restricted range showing endemic development. Nevertheless, it is possible to point out a few cases which confirm the data above produced. Thus a Glycymerid (*Veletuceta howensis*) is of New Caledonian form rather than Australian, and definitely not of Neozelanic origin. However, a *Eucrassatella* points to East Australia again as this group is peculiarly Australian, and is not found in New Caledonia, and only one unlike species occurs rarely in New Zealand. The small Giant Clam, *Vulgodacna fossor,* common on the Lagoon reef, is scarcely separable from the one occurring on the Capricorn Group, while northwards in Queensland it shows more variation. The majority of the bivalves are of northern origin, *Fragum unedo,* the well known Strawberry Cockle, and *Lentillaria paytenorum,* the saucer shell abounding on the beaches.

Among the Opisthobranchiate faunà, many interesting species were noted. Some of these showed East Australian relationship, while others were typical Indo-Pacific forms, with a closer relationship possibly to New Caledonia. None was closely related to Neozelanic forms, for while some of the genera also occur in New Zealand, these were easily recognised as of tropical origin and only stragglers in the New Zealand fauna. A large collection was made in a short time, as they are equally abundant on both sides of the island. The large sea-hare, *Tethys angasi,* of Eastern Australia, was very common, and Whitley found it at Middleton Reef, and also at Rarotonga. *Dolabrifera brazieri,* one of the commonest non-swimming sea-hares of the New South Wales and Queensland coasts, was also common at all three places. It may be noted that a smaller species occurred with this and is probably undescribed, as it is not known from the East Australian coast. The genus *Dolabella,* which is common in Queensland and is represented in New South Wales by *D. andersoni,* also occurs, the species being more closely allied to the southern form. The above are all tropical genera reaching down the East Australian coast and unrepresented in New Zealand. There, however, is in New Zealand a small *Tethys* (*tryoni*) which closely resembles *T. norfolkensis,* common at Lord Howe Island, Norfolk Island and Eastern Australia.

Stylocheilus, a notable Indo-Pacific genus of sea-hares, with at least two unnamed representatives round Sydney, occurs at Lord Howe Island in a small, but abundant, species very distinct, but approaching one of the Sydney forms. The genus *Ramosaclesia* found at Sydney and with a New Zealand representative, *glauca,* was not observed at Lord Howe Island, though a species not easily overlooked.

Among the Nudibranchiate Opisthobranchs some very interesting forms were collected, mostly belonging to Indo-Pacific genera as *Dendrodoris, Platydoris, Discodoris, Hexabranchus, Phyllidia, Cyerce, Bornella, Chromodoris,* etc., none of which are typical of New Zealand, although stragglers have been found in the North Island. It may be stated that on examination of the Lord Howe Island material (many of which may prove to be unnamed species) this bears a closer relationship to the New Caledonian species than to any other. Many of the species recorded

by Risbec from New Caledonia have appeared at Lord Howe Island, though generally these have a wide Indo-Pacific range.

The large *Hexabranchus marginatus* which ranges through the Indo-Pacific to Queensland and New Caledonia is common at certain times at Lord Howe Island, while *Bornella digitata,* common at New Caledonia, is also common here, and even reaches East Australia. A small *Chromodoris* which may even be *Chromodoris tenuis* from New Caledonia, occurs everywhere, while *Phyllobranchus prasinus* and *Cyerce nigra* recorded from New Caledonia and the Philippines reappear here. However, an *Elysia, E. marginata,* found at Lord Howe Island and then by Whitley at Middleton Reef is not recorded from New Caledonia, though the type locality is the Island of Huaheine, east of New Caledonia.

Many nudibranches were collected, but this difficult group takes time to determine each species, so the generic names will only be mentioned here. Several species of *Nembrotha,* a *Notodoris,* a *Sclerodoris* occurred, all of general Indo-Pacific alliance. *Discodoris palma* was also fairly common, a rather well known East Australian form, but only one *Aeolid* was noticed, though Aeolids are rather common in East Australian waters and many species have been recorded from New Caledonia. The same remarks as to general relationship of the nudibranchs apply as given for the sea-hares. Of general Indo-Pacific groups the species seem more closely related to New Caledonian ones than otherwise. The Pleurobranchs confirm this, as the commonest ones seem inseparable from the Sydney *ornata,* and the others are of Indo-Pacific form.

Umbraculum also occurs and the species may be *botanica,* but this genus is difficult to determine specifically. The conclusion may be reached that most species have reached Lord Howe Island by way of New Caledonia.

There is, however, a novel angle from which examination of molluscan relationships can now be made, and that is by comparison of the micro-forms found living under stones below low water and sorted out of shallow water dredgings. When at the Kermadecs, Iredale and Roy Bell dredged, and the minute molluscan faunula thereby procured showed a large proportion of novelties. It was concluded at the time that this might be due to the lack of similar dredgings from other neighbouring localities, e.g., Lord Howe Island, Norfolk Island, and New Caledonia. Since, Roy Bell has dredged similarly at Lord Howe Island and Norfolk Island, while Iredale secured material at the Capricorn Group and also received dredgings from New Caledonia. Briefly, it can now be stated from criticism of this micro-mollusca secured at the above localities that the Lord Howe Island forms show a closer relationship to the New Caledonian and suggest a weaker or older Australian one.

As Norfolk Island has been previously so continuously associated zoologically in discussions upon Lord Howe Island, a few words may be added on this point. The association seems very weak, the East Australian forms abovementioned being generally absent, and the New Caledonian affinity missing. The most curious mollusc found at Norfolk Island is a Cominellid, *Cominista norfolkensis,* which is quite unlike the New South Wales *filicea,* but is very close to the New Zealand type of *Cominista, glandiformis* (olim. *lurida*). No Cominellid lives at Lord Howe Island or at New Caledonia, though the family shows thirteen species and three sub-species in the latest New Zealand List by Powell. This would suggest close connection with New Zealand, but this is negatived by the fact there are no Limpets at Norfolk Island, while these are abundant in New Zealand.

On the other hand, a "Gena" (*Plocamotis illusus*) occurs on Norfolk Island, and this is nearer the East Australian (Sydney) species than the New Caledonian *caledonica* which, however, recurs in North Queensland but has not been found at Lord Howe Island. Really there is little individuality in the Norfolk Island marine molluscan fauna, although there is much in that of Lord Howe Island. However, the Norfolk Island land molluscan fauna is very peculiar and quite unlike that of Lord Howe Island, and is closely related to that of the Fiji Group. The results of the preceding analysis may be itemised thus:—

(1) Lord Howe Island is the remnant of a long tongue reaching from New Caledonia to a much more westward point than at present, much closer to the East Australian coast, though never in actual contact. If even there was a land connection with New Zealand it must have been at a very remote period. There has never been a land connection with Norfolk Island.

(2) There is strong evidence of a land bridge or series of stepping stones connecting New Caledonia with southern Queensland by way of the Capricorn Group, and almost or completely closing the Coral Sea on the southern side.

(3) Lord Howe Island has suffered many depressions and elevations, but has never been completely submerged. The land mollusc, *Placostylus,* is evidence of the latter fact.

REVIEW.

Sharks!!!

The Fishes of Australia. Part I. Australian Zoological Handbook, published by the Royal Zoological Society of New South Wales. Price, 7/6.

The first part of a projected series of Handbooks dealing with the Fishes of Australia is now on sale. It is a handsome book of 280 pages Imperial octavo, printed on art paper and with over 300 illustrations, and has been prepared by Mr. G. P. Whitley, F.R.Z.S. This part is complete in itself and can be purchased without any liability for purchase of the other parts. These Handbooks are provided for the use of laymen and scientists alike, dealing with the subject popularly, but with the accuracy demanded by the scientific worker, at an inexpensive price. As a layman I welcome this first part which, dealing with Sharks, Rays and suchlike, is the most comprehensive work on this subject ever attempted. Its contents are encyclopaedic and everyone will find much of interest whatever his viewpoint may be. The scientist can peruse and study (criticise if he be able which I doubt) with profit, the literary student will also uncover gems unexpected under such a title, the artist will be pleased with the numerous illustrations, while even the anatomist will meet with novel dissections of merit. Moreover, all the shark tragedies are catalogued and the shark industry is described in detail, while figures of the curious teeth and quaint egg cases are given.—TOM IREDALE.

BREEDING THE GIRAFFE (*GIRAFFA CAMELOPARDALIS*).

By Robert A. Patten, B.V.Sc.

(*Superintendent and Curator, Taronga Zoological Park Trust, Mosman.*)

(Plates xxxv. and xxxvi.)

The Giraffe has always attracted considerable attention, probably due to the fact that it is by far the tallest mammal in the world, its height being up to 18 feet. Its long legs and neck account principally for its great height, the forelegs being much longer than the hind legs, and the back slopes away from the withers to the tail. The so-called horns, two in number, are really bone and are covered with skin and surmounted at the tips with dark brown hair. These bony prominences are present in both sexes from birth. The creature has a particularly long tongue, some eighteen inches in length, and with the help of a long upper lip, is well equipped to reach and grasp the leaves and twigs of the Acacia tree on which it mostly feeds.

In captivity, one often sees Giraffes licking the rails of the fenced enclosure, and this habit of the adult was soon copied by a calf born in these gardens, when it grew tall enough to reach the objective.

Giraffes are usually divided into two species, the Northern and Southern. Those dwelling in the North hail from Abyssinia and the terrain thereabout. These animals are generally darker brown in colour with fine white lines separating the coat into innumerable polygonal figures or blotches. The Southern species ranges from near Kenya to the Transvaal. It is much lighter in colour, having tawny irregular blotches on a fawn background similar to the Taronga Park exhibits.

Equipped by Nature with such a covering, the Giraffes furnish one of the finest examples of camouflage. Standing still beneath the Acacia trees, the light and shade almost make the creatures invisible. The habits are similar wherever they are found; they frequent open country; thick jungle and marshy ground is unsuitable to them. They live in herds, often associated with Zebras, Ostriches and Antelopes. Feeding on green leaves, they are able to go a long time without water, but when they do drink they are compelled to straddle their forelegs wide apart to enable the mouth to reach the ground. Owing to their extraordinary build, they have a most ungainly gallop as they lift the front and hind limbs of the same side in a manner similar to the camel.

The two adult animals on view at Taronga Zoological Park were formerly rather difficult to keep in good health until it was suspected that parasites might have been a contributing cause. When a microscopic examination of the faeces was made it disclosed the presence of a considerable Trichostrongylid infection. Systematic examinations of the excreta every few months are now carried out and medicinal treatment follows immediately, whenever parasitic eggs are found in any great numbers. Grass and sandy floors within the enclosure are contributing factors to Giraffes reinfesting themselves as the eggs are swallowed with the food.

These African mammals are docile, silent and haughty creatures; they move around their yard with a high and mighty air of indifference to the neighbouring exhibits.

The two Giraffes at Taronga Park were received on November 24, 1935, from C. Schultz, of Tanganyika, who captured them in that part of Africa.

They reached maturity in 1937, their age being six years. The first calf was born on 16th June, 1938, but succumbed to injury at birth.

In view of the fact that no previous offspring from these animals (or for that matter any Giraffes exhibited in any part of Australia) has been successfully raised, certain precautions were taken to obviate accidents and to provide the next expected calf and also the mother with all facilities at our disposal.

The gestation period being fifteen months, the parents were mated at a time that would ensure the coming of the calf at the most favourable time, and the month of November was therefore selected to avoid the cold winter months and to enable the young one sufficient time, should it live, to establish itself during the warm summer weather. The animals were seen only once in the act of coition which occurred late in the evening.

Three months before the anticipated birth, a special yard was erected and the mother isolated from the male. This smaller enclosure adjoined the main one; the dividing fence was constructed of galvanised piping and chain wire, which enabled male and female to see each other at all times so that on reunion they would not be strange to one another. By thus separating them we considered it would be possible to quieten the female and, if any future trouble should arise, assistance could be rendered. It was thought that unless we could do this our task would be more or less hopeless in the event of a difficult birth, but this arrangement placed us in a position to notice anything of interest connected with this matter.

This housing in a small and secluded yard subsequently proved invaluable to us, as the mother did require some aid, and fortunately, as the birth occurred a little before noon, we were on hand and able to carry out the operation successfully.

It is interesting to note that the birth actually took place with the mother in the standing position. When labour commenced the pregnant animal walked round and round the yard straining and, although she occasionally assumed a more or less squatting position, at no time did she rest her weight on the ground. After the foetal envelopes ruptured with the release of the waters, only the forelegs were presented. As considerable straining now took place, an examination was made and the head of the foetus was found to be bent back over the neck. This was subsequently righted and moved to the normal position; afterwards the mother was assisted in the delivery of the calf which took place without injury to the young.

The mother at once commenced cleaning the calf but, unlike a number of other wild animals, did not eat the placenta. The young one was placed on clean straw and two hours from birth was able to stand with difficulty. For the first two days its gait was most unsteady; its limbs did not straighten until it was eight days old. Its height at birth measured 6 ft. 4 in. from the ground to the top of the horns.

Other interesting observations recorded were:—Length of body, 1 ft. 10 in. Length of head, 1 ft. 1 in. Neck, 1 ft. 10 in. Tail, 1 ft. 4 in. Length of ears, 8in. Body girth, 3 ft. 4½ in. Measurement around muzzle, 11 in. Cannon bone foreleg, 1 ft. 7 in. Hind cannon bone, 1 ft. 7 in. The bony growths on the head, two in number, were loose and not firmly attached to the skull, each being surmounted by a tuft of dark chestnut coloured hair 3 in. long; the bony growths or horns were each 2 in. in length.

Six incisor teeth were present at birth: the corner pair was not quite through the gums. The weight of the previous calf that died at birth was

140 lb., and we feel sure that this well-nourished young animal was at least of similar weight.

It is remarkable how a female Giraffe is capable of carrying such a large and heavy foetus. Even more remarkable is the rapid growth of the offspring after birth, but no doubt this is due, not only to natural growth itself, but also to the fact that the various muscles covering the body are greatly compressed *in utero*.

An interesting record of the growth of the calf over a period of twelve months is attached:—

	ft.	in.		ft.	in.
1939—Nov. 8 (at birth) ..	6	4	1940—May 1	9	5
Nov. 22 (2 weeks)	6	11	June 1	9	9
December 1	7	8	July 1	10	1
1940—January 1	7	11	August 1	10	5
February 1	8	4	September 1	10	9
March 1	8	9	October 1	11	0
April 1	9	1	November 1	11	4

In observing the progress of this young animal, we were pleased to note the wonderful maternal instinct of the mother, who would at all times shield it when disturbed or frightened; from its wonderful progress it was manifest that the nourishment provided by her was abundant.

At five weeks of age the calf followed its mother's example of frequently washing its mouth at the water receptacle provided, and at this stage would occasionally endeavour without success to nibble a small portion of green lucerne.

At three months the calf really did partake of and masticate a small amount of green lucerne and lucerne hay. At four months it actually commenced feeding daily and regularly from a small box placed some six feet from the ground, and at this stage the young one copied the mother by licking and rubbing its gums over the top of the rail of the enclosure.

From this time onwards it would consume and apparently enjoy a portion of the mother's food, consisting of green lucerne, lucerne hay, bread, pollard, bran, cornmeal, grain, cocoanut meal, carrots and a little bone flour.

At twelve months of age the mother is still supplying a certain amount of nourishment to the calf.

As little data is available in connection with the rearing of young Giraffes in captivity, it was deemed advisable to keep the male separate until such time as it was thought that the little one could more or less take care of itself. Bearing in mind the desirability of a future increase, the male was not allowed to join the mother and calf until the latter had reached the age of nine months.

The keeper and myself both were a little apprehensive as to what would happen on reunion, but our uneasiness was fortunately groundless for nothing of an adverse nature transpired.

It was difficult to say really which one appeared the most pleased. The father certainly lost little time in making a close inspection of his vigorous son, who seemed quite at ease and unperturbed.

Fig. 19. Painted Flute-mouth, *Aulostomus chinensis waitei.* Holotype of subspecies.

Fig. 29. Portuguese Man-o'-War Fish, *Nomeus dyscritus.*

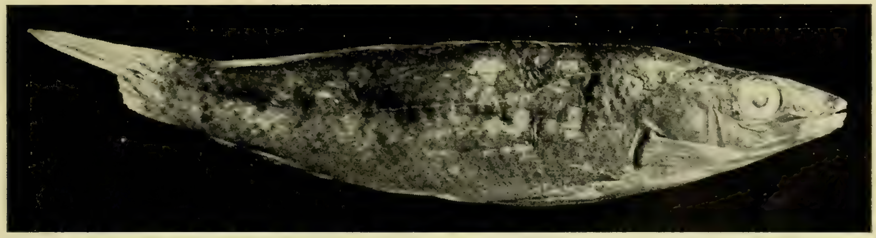


Fig. 41. Little Rock Whiting, *Neoodax balteatus* (Type of *Odax obscurus*).

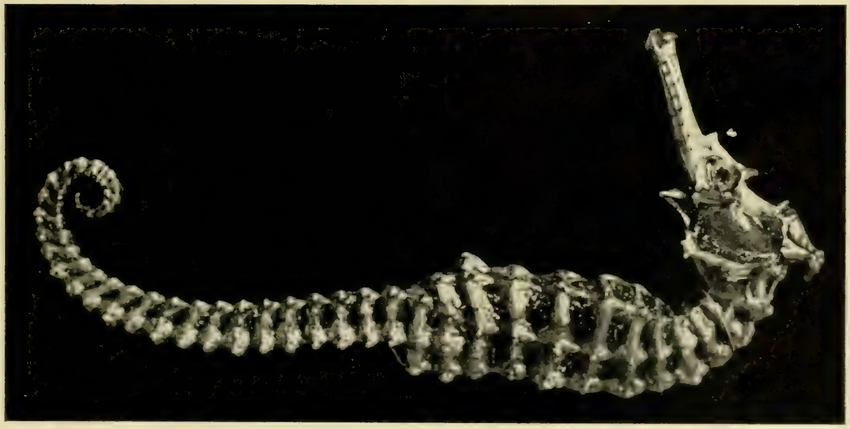


Fig. 20. Sea Horse, *Hippocampus angustus* (Type of *H. subelongatus*).

Fig. 24. Pipefish, *Festucalex cinctus.* Topotype.

Fig. 38. Angel Fish, *Chaetodontoplus duboulayi.*

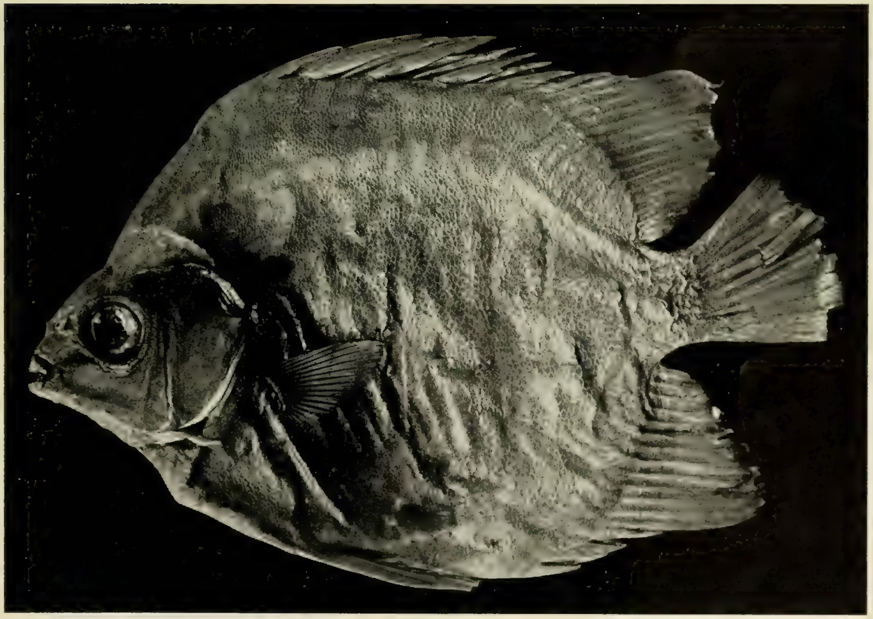
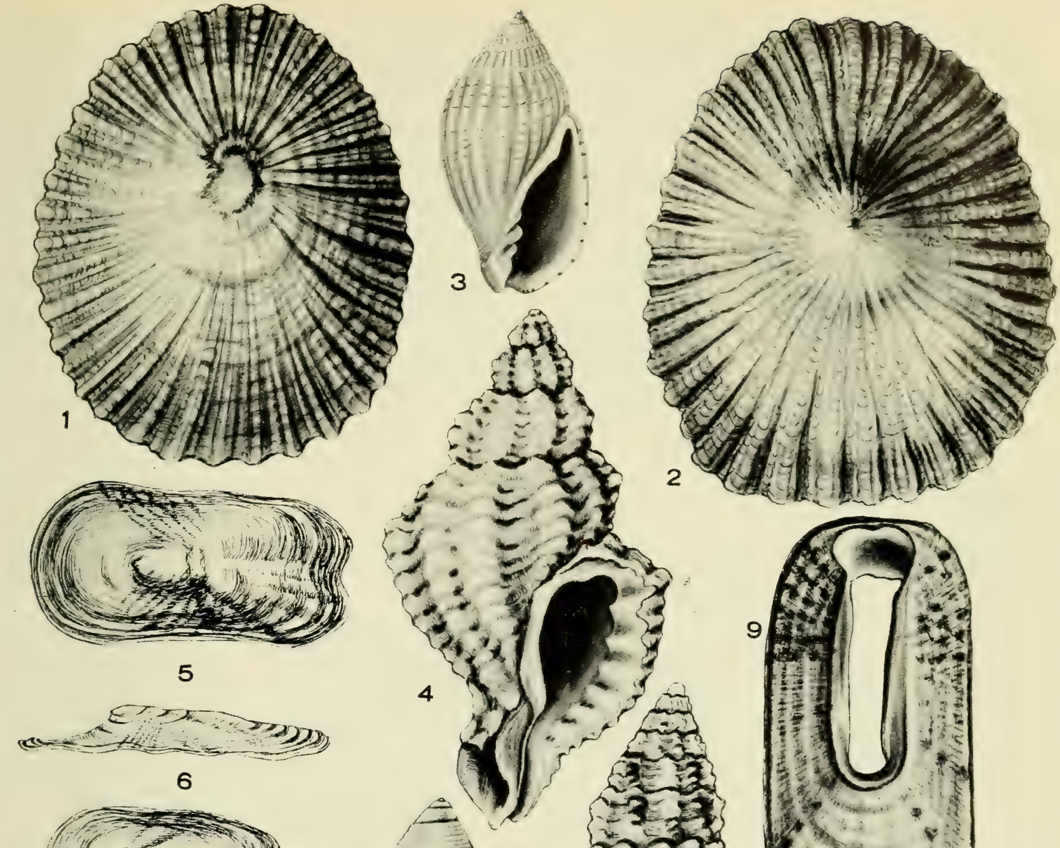
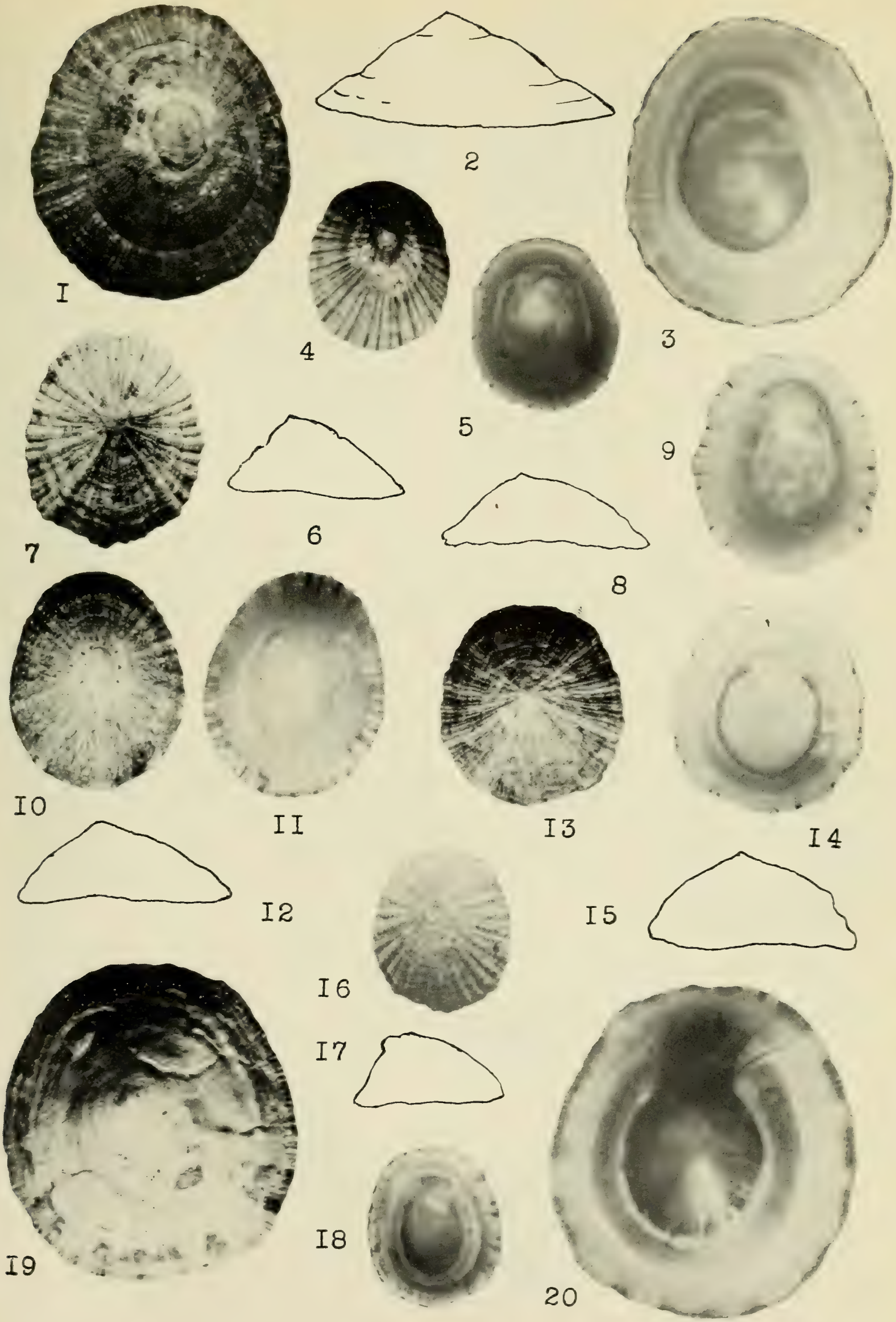


Fig. 39. Butterfish, *Selenotoca aetate-varians* (Type of *Scatophagus multifasciatus* var. *altermans*).



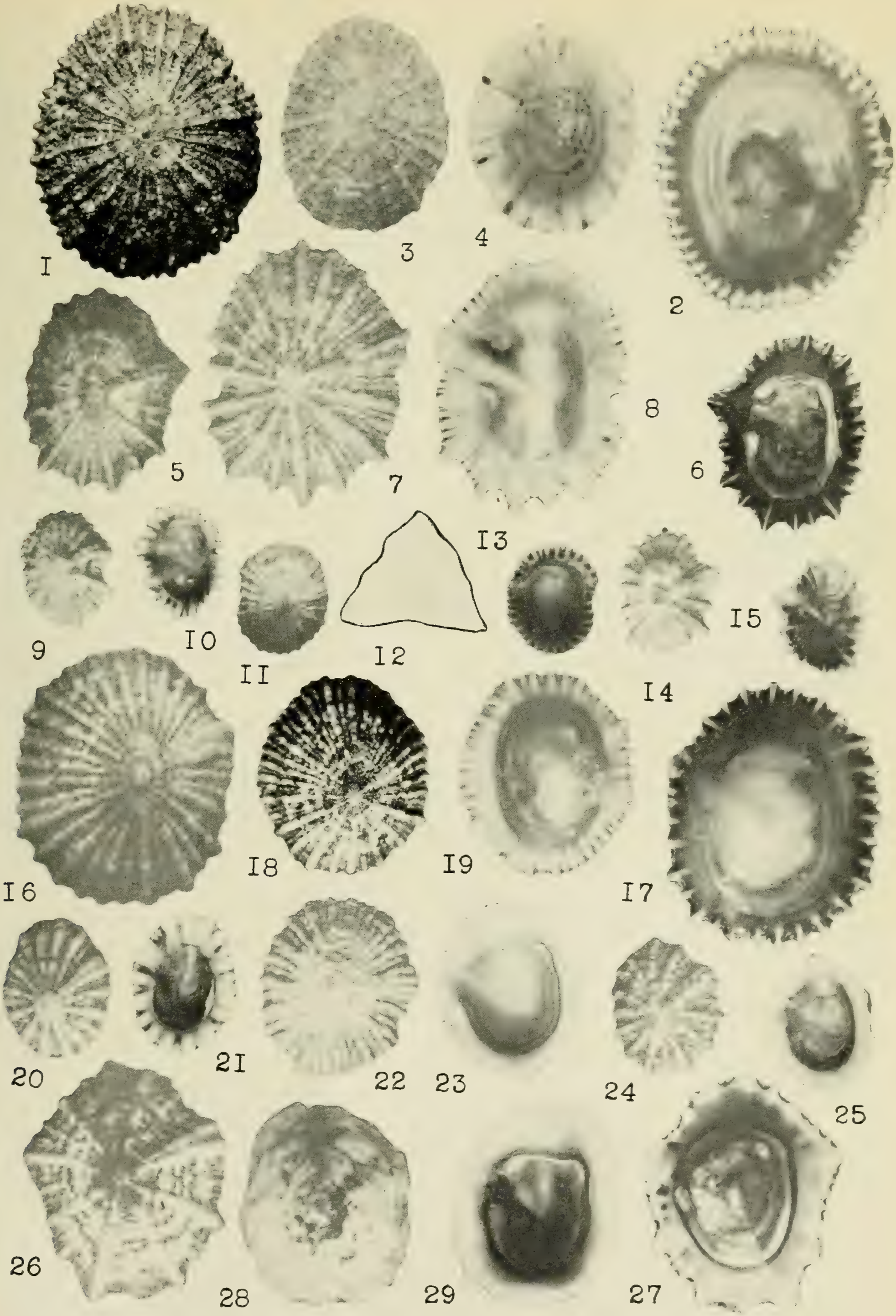
LORD HOWE ISLAND, ETC., MOLLUSCA.

Joyce Allan del.



LORD HOWE ISLAND, ETC., MOLLUSCA.

Photographs by G. C. Clutton.



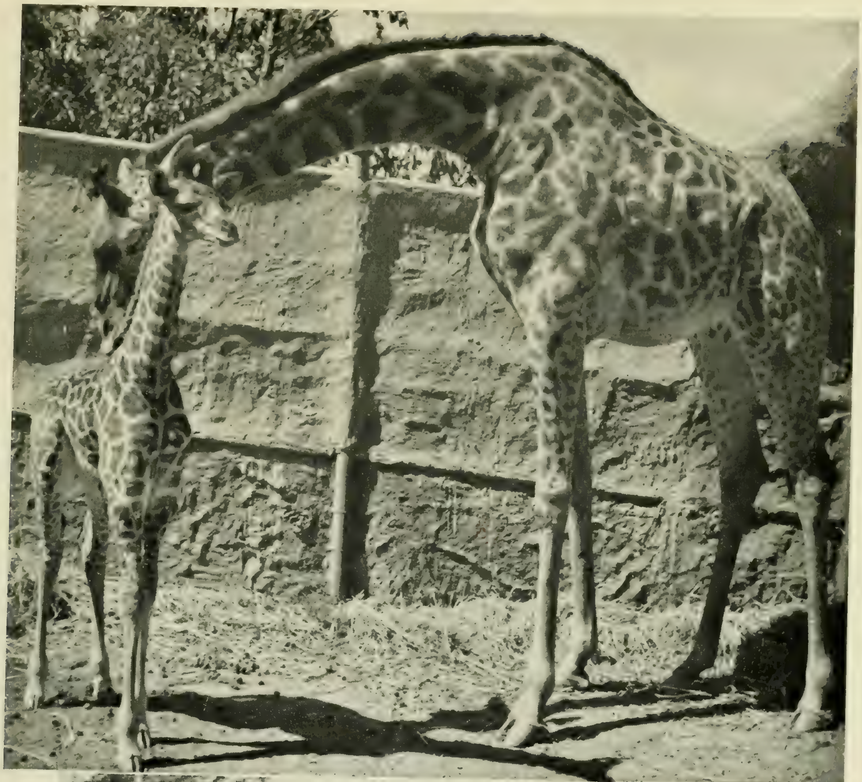
LORD HOWE ISLAND, ETC., MOLLUSCA.

Photographs by G. C. Clutton.

Mother cleaning calf shortly after birth.

Calf attempting to support itself on its legs.

Photographs by R. A. Patten.



Top: The calf at 10 days. Lower: Family reunited after 9 months.
Photographs by R. A. Patten.

Royal Zoological Society of New South Wales.

MEMBERSHIP.

Class.	Amount of Subscription.
Associate Member	5 0 per annum.
Ordinary Member	£1 0 0 ,,

[Members joining after 1st January in any year pay one-half subscription.]

Life Associate Member	£2 10 0 in one sum.
Life Member	£10 0 0 ,,
Honorary Associate Member	No subscription. Elected for services to Australian Zoology or to the Society.
Honorary Member	

TITLES.

(Conferred by the Council.)

Fellow	For distinguished services to Australian Zoology.	
Associate Benefactor.	For contribution of	£100 to the Society's Funds.
Benefactor	,, ,,	£500 ,, ,, ,, ,,
Endowment Member	,, ,,	£1,000 ,, ,, ,, ,,

PRIVILEGES.

Members of all classes may attend all meetings of the Society and its various Sections. Every member (other than an Associate or Life Associate member) receives a free pass to Taronga Zoological Park and Aquarium, and twenty tickets each year, admitting 20 adults or 40 children to the Park only.

APPLICATION FOR MEMBERSHIP

should be addressed to the Honorary Secretary, Box 2399 M.M., G.P.O., Sydney, accompanied by a remittance of the amount of subscription. The number of Ordinary Members is limited to 350, and should there be no vacancy at the time of application, the applicant will be registered as an Associate Member, and shall take precedence in accordance with the date of his admission to Associate membership.

PUBLICATIONS.

"The Australian Zoologist"

A Journal containing papers relating to the Zoology of Australia. Published at irregular intervals. Subscription to ordinary members elected prior to July 1, 1933, 1/- per annum; ordinary members elected after June 30, 1933, and all associate members, 2/6 per annum.

Vol. No.	Parts.	Date.	Pp.	Plates.	Price (unbound). £ s. d.
I.	8.	1914-20.	256.	19.	1 0 0
II.	4.	1921-22.	172.	45.	12 6
III.	8.	1922-25.	362.	41.	1 0 0
IV.	6.	1925-27.	362.	49.	1 0 0
V.	4.	1927-29.	362.	41.	1 0 0
VI.	4.	1929-31.	394.	32.	1 0 0
VII.	5.	1931-33.	398.	23.	1 0 0
VIII.	4.	1934-37.	346.	19.	17 6
IX.	4.	1937-40.	454.	36.	1 0 0

Note:—Single parts of any volume may be obtained at published prices, less 20 per cent. to members or associates. Prices may be ascertained on application to the Honorary Secretary.

PUBLICATIONS (Continued).

AUSTRALIAN ZOOLOGICAL HANDBOOKS.

The Fishes of Australia, Part I, "Sharks and Rays", by Gilbert P. Whitley, F.R.Z.S. 280 pp., and over 300 illustrations. Price, 7/6. Postage: Australia, 5d. British Possessions, 7d. Foreign, 11d.

(**Note**: "The Fishes and Fish-like Animals of New South Wales" is out of print.)

A Monograph of the Australian Loricates, by Tom Iredale and A. F. Basset Hull. 168 + xiii. pp., 21 plates and portrait. Price, 5/-. Postage: Australia, 5d. British Possessions, 9d. Foreign, 1/6.

Bibliography of Australian Entomology, 1775-1930, by Anthony Musgrave, F.E.S. 380 + viii. pp. Price, 10/-. Postage: Australia, 6d. British Possessions, 9d. Foreign, 1/6.

Australian Spiders and Their Allies, by W. W. Froggatt, F.R.Z.S. Price, 2/6. Postage: Australia, 1d. British Possessions, 2d. Foreign, 3d.

CONTENTS OF THIS PART.

"THE AUSTRALIAN ZOOLOGIST."

Communications intended for "The Australian Zoologist" should be typewritten.

Authors should state whether proofs and reprints are desired when submitting MS. Fifty reprints of any article appearing under a separate title will be supplied gratis. If more are required, terms may be ascertained on application to the Editor.

Wholly set up and printed in Australia by the Sydney & Melbourne Publishing Co. Pty., Ltd., 29 Alberta St., Sydney.